Institute of Engineering and Technology

Department of Mechanical Engineering

Handbook
for
B. Tech ME (Batch 2019-23)

CONTENTS

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Apply their technical knowledge, complex problem solving and research skills in professional practice

PEO2: Continue their intellectual development through critical thinking, self-study, apprenticeship, higher education, professional development courses, as well as participation in research groups and professional networks

PEO3: Serve as ambassadors for engineering and sustainability by exhibiting high professional standards with a deep sense of civic responsibility.

PEO4: Effectively communicate about technical and related issues.

PEO5: Embrace the roles of team members and leaders in their careers.

PROGRAM OUTCOMES (POs)

PO1 **Life-long learning:** Demonstrate inquisitiveness, open mindedness, and the ability to engage in independent and life-long learning in the broadest context of technological, organizational, economic, and societal changes.

PO2 **Citizenship, Sustainability, and Professional ethics**

2a: Demonstrate knowledge of constitutional values of liberty, equity, justice, and fraternity with an understanding of the impact of the engineering solutions in societal and environmental contexts as well as a sense of responsibility for sustainable development.

2b: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, cultural, and environmental issues and the consequent responsibilities relevant to professional engineering practice.

2c: Demonstrate commitment for professional integrity and excellence and respect for ethics, responsibilities and norms as prescribed for the engineering practice.

PO3 **Engineering knowledge and Modern tool usage**

3a: Demonstrate a clear conceptual understanding of the fundamentals of engineering specialization and cognitive flexibility to appropriately 'transfer' what has been learned in a context, to different situations.

3b: Apply engineering thinking, computational thinking, and the knowledge of mathematics, natural and social sciences, engineering fundamentals, information technology, engineering specialization, and engineering management to the solution of complex engineering problems.

3c: Create, select, modify, and apply appropriate techniques, best practices, standards, resources, and modern engineering and IT tools including prediction and modeling to engineering and social activities.

PO4 **Complex problem solving, Design and Research**

4a: Identify, formulate, review research literature, and analyze complex engineering problems to arrive at substantiated conclusions using critical thinking along with principles of mathematics, computing, engineering as well as natural and social sciences.

4b: Use systems thinking and reflection to identify and consider underlying structures, patterns, volatility, uncertainties, complexities, ambiguities, complications, and risks to design and develop engineering solutions for complex problems to meet the specified and anticipated needs with appropriate concern for constraints, performance, sustainability, and professional ethics.

4c: Use research-based knowledge and research methods including design of experiments, simulation, analysis and interpretation of data, and synthesis of the information to evaluate and improve the engineering solutions and practice.

PO5 **Individual & teamwork and Engineering management**

5a: Ability to work effectively as an individual and as a team member or a leader in diverse and distributed teams, and in multidisciplinary settings.

5b: Ability to apply engineering management principles to one's own and team's work to manage engineering projects and operations and in multidisciplinary environment.

PO6 **Communication:** Ability to communicate effectively on complex engineering and technology activities, situations, problems, and solutions using verbal, textual, and pictorial elements with the colleagues, engineering community, users, clients, policy

makers, and society at large with intellectual honesty, clarity, empathy, and compassion.

PO7 Innovation and entrepreneurship:

7a: Demonstrate enthusiasm and understanding to identify opportunities and translate research in engineering and other disciplines to conceive and design innovative engineering solutions for business, industry, and societal problems.

7b: Demonstrate enthusiasm and understanding to conceive and plan technology based new ventures either as independent start-up businesses or within existing corporate structures.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1. Conceive, design, implement and manage mechanical systems, components, and processes by using principles of machine design, production engineering, thermal engineering, computing, automation, sustainability and contemporary materials and tools.

PSO2. Serve in fields of engineering services, manufacturing, automobile, energy, EPC and mechatronics.

JK Lakshmipat University, Jaipur
Institute of Engineering and Technology
Department of Mechanical & Engineering
Course Structure for the B. Tech (Batch 2019-2023)

Sem	Courses							Credits
I	Computational Data Analysis	Design and Prototyping	Experimental Science-I	Fundamentals of Communication				**21**
	ES1101	**ES1102**	**AS1101**	**CC1101**				
	(10s 2 0)	**(6s 0 0)**	**(1 0 4)**	**(2 0 1)**				
	10	**6**	**3**	**2**				
II	Calculus and Applied Mechanics	Fundamentals of Automation Engineering	Object Oriented Programming (Java + Simple Database)/ Python Programming	Energy and Environmental Studies	Critical Thinking and Power of Storytelling	Scientific Perspectives (Science Week)		**20**
	ES1103	**ES1104**	**CS1101 / CS1301**	**ES1105**	**CC1102**	**AS1102**		
	(6s 2 0)	**(6s 2 0)**	**(1 0 4)/(0 2 0)**	**(1 0 0)**	**(2 0 1)**			
	6	**6**	**3**	**1**	**2**	**2**		
III	Materials Engineering	Computational Engineering Analysis-I	Engineering Measurements and Machines	Engineering Thermodynamics	Perspectives on Contemporary Issues	Management Perspectives		**22/25***
	ME1101	**ES1106**	**ES1107**	**ME1102**	**CC1103**	**IL1101**		
	(3 0 2)	**(3 1 2)**	**(3 0 4)**	**(3 0 2)**	**(2 0 1)**			
	4	**5**	**5**	**4**	**2**	**2**		
IV	**Transport Phenomena**	**Strength of Materials and Analysis**	**Computational Engineering Analysis-II**	**Production Technology-I**	Communication and Identity	Introduction to Design (Design Week)	Mechanical Engineering CAD Lab	**23/24***
	ME1104	**ME1105**	**ES1109**	**ME1106**	**CC1104**	**IL1102**	**ME1107**	
	(3 0 2)	**(3 0 2)**	**(3 1 2)**	**(3 0 2)**	**(2 0 1)**		**(0 0 4)**	
	4	**4**	**5**	**4**	**2**	**2**	**2**	
Practice School - I (PS1101) – (4 to 6 Weeks Duration) - 4 Credits								
V*	Theory of Machine	Production Technology- II	DE-1	OE-1	Understanding and Managing Conflict	Introduction to IoT	Automation Projects	**22**
	ME1108	**ME1109**			**CC1105**	**EE1111**	**PR1101**	
	(3 0 2)	**(3 0 2)**			**(2 0 0)**			
	4	**4**	**4**	**4**	**2**	**2**	**2**	
VI*	Design of Machine Elements	DE-II	Automobile Engineering	DE-III/ OE -II/ Minor Project	Critical Thinking for Decisions at Workplace	Emerging Tech Week		**20**
	ME1110		**ME1111**		**CC1106**			
	(3 0 2)	**(3 0 2)**	**(3 0 2)**		**2**	**2**		
	4	**4**	**4**	**4**	**2**	**2**		
VII*	DE-4	DE-5	DE-6	OE-3	Minor Project			**20**
					PR1103			
	4	**4**	**4**	**4**	**4**			
VIII*	Practice School - II /Entrepreneurial Project/Research Project/Semester at a partner University							**16**
							Total Credits	**165-166***

Note * semester yet not started

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B.Tech (ME) (Batch: 2019-2023)			
Sr. NO	**Course Code**	**Course Name**	**Page No.**

Course Title and Code: Experimental Science-I: AS1101	
Hours per Week	**L-T-P: 1-0-4**
Credits	**3**

Course Objectives:

This course is designed to familiarize the student with the fundamental concepts of different phenomenon related with optics, electrical & electronics, modern physics, properties of water and lubricants. This course will expose the students with experimental methods of physics, chemistry and integrates theoretical knowledge and concepts to practical experience.

Learning Outcomes:

On successful completion of this course, the students will be able to:

1. analyze ferromagnetic properties of any magnetic material and differentiate Soft and hard materials.
2. analyze thermoelectric effect of metal junctions due to temperature differences.
3. analyze nuclear radiation with respect to distance and thickness of absorbing media.
4. measure electrical properties e.g. specific resistance, time constant of various electrical components.
5. use Schroedinger equation and quantum mechanical approach to analyze behavior of the quantum particle under different potentials.
6. differentiate hard and soft water by determining it's hardness of different water samples.
7. analyze conductivity of samples by different techniques such as volumetric titrations and conductometric.
8. determine properties of the lubricant/oil samples by Pensky-Martens and Red Viscometer.

Prerequisites		**Knowledge of Basic Science**
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	5
03	Class Participation	5
04	Quiz	10
05	Theory Exam	Nil
06	Theory Exam	Nil
07	Theory Exam	20
08	Report-1	Nil
09	Report-2	Nil
10	Report-3	10

11	Project -1	Nil
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation-1 (Continuous)	20
15	Lab Evaluation-2 (Exam)	30
16	Course portfolio	Nil
	Total (100)	**100**

Syllabus:

Electromagnetism, B-H Curve, Thermo-emf, Nuclear radiation detection, Linear air track, charging discharging of capacitors, Conversion of galvanometer into ammeter/voltmeter, Specific and high resistance determination, Concept of quantum mechanics, Schrodinger equation and quantum mechanical approach to analyze behavior of the quantum particle under different potentials, Water analysis for hardness, PH, Alkalinity, oxygen & chloride content, conductometric titrations, Viscosity of lubricant oil, Science of solids.

Course Title –Fundamentals of Communication- 2 credits (2-0-1)
Course Code- CC1101
Semester- I

Course Description

This course provides an introduction to the importance of effective communication, the consequences of poor communication, and the different elements of verbal and non-verbal communication. Students learn about, and enhance, the components of communication: kinesics, paralanguage (voice) and language.

Learning Outcomes

The students will be able to:

- Identify different cultural differences and their impact on communication.
- Compose grammatically correct sentences and paragraphs.
- Deliver effective oral presentations following appropriate kinesics and paralinguistic features.
- Identify impact of cultural differences on communication.
- Apply appropriate communication skills across settings, purposes, and audiences.

Topics to be Covered

1. Nature and importance of communication
2. Mehrabian's Communication Theory
3. Ethos, Pathos, Logos: The three pillars of persuasive communication
4. English as a Foreign Language
5. Consequences of poor communication
6. Writing Strategy
7. Basic of Effective Presentation
8. Influence of culture on communication
9. Formats of Public speaking (oral narration, conversational skills)
10. Common Errors in English

SUGGESTED READINGS:

1) Raman, Meenakshi and Sangeeta Sharma, 2011. Technical Communication: Principles and Practice. Second Edition. New Delhi: Oxford University Press.
2) Mohan, Krishna and Meenakshi Raman. 2010. Advanced Communicative English. New Delhi: Tata McGraw Hill.

Evaluation Scheme:

Fundamentals of Communication		
Prerequisites		
Hours per Week: 2 hours		**L-T-P: 2-0-1**
Credits		**2**
Course Code		**CC1101**
Sr. No	**Specifications**	**Weightage (in percentage)**
1	Attendance	Nil
2	**Assignments**	**30**
3	**Class Participation**	**10**
4	**Quiz**	**20**
5	Theory Exam I	Nil
6	**Theory Exam II**	**20**
7	**Theory Exam III**	**20**
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	Nil
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation	Nil
15	Lab Evaluation	Nil
16	Course portfolio	Nil
	Total (100)	**100**

ES1101: Computational Data Analysis

Course Description: This course introduces computational analysis of data based on Linear Algebra Principles and Statistics. The computational analysis will include learning and utilizing Python as a programming language.

Learning Outcome

After course completion, the student will be able to

1. Write Simple Python programs using various datatypes, control structures, decision statements, libraries, functions (M1)
2. Develop Python programs using Objects, Classes and Files (M1, M2)
3. Develop Programs for analyzing and interpreting Complex situations in various domains including sustainable development by combining various Linear Algebra, Statistics and Other Problem Solving Techniques (M3)
4. Model Complex systems as Linear simultaneous equations and analyze the same using Matrix methods (M1)
5. Model Data as matrices and Find Eigen Values and Eigen Vectors and Apply the same for problem solving, e.g., ranking and performance analysis (M1)
6. Summarize and Visualize different datasets (M2)
7. Analyze and interpret different datasets using Discrete and Continuous Probability Distributions and Apply the same for problem solving, e.g., Goodness of Fit (M2)
8. Formulate and validate hypothesis with reference to different datasets (M2)
9. Apply correlation, regression, least square method and time series analysis for modeling, analysis, interpretation and forecasting (M2)

Teaching Scheme and Credits

Hrs. per Week		Credits	Duration in Weeks
In Class	Out Class	10	15
10+2	20		

Evaluation Scheme

Sr. No	Specifications	Weightage (in percentage)
01	Attendance	Nil
02	Assignment	15
03	Class Participation	Nil
04	Quiz	15
05	Theory Exam (Mid Term I)	Nil
06	Theory Exam (Mid Term II)	20
07	Theory Exam	Nil
08	Report-1	Nil

09	Report-2	Nil
10	Report-3	Nil
11	Project -1	Nil
12	Project -2	30
13	Project -3	Nil
14	Lab Evaluation 1	10
15	Lab Evaluation 2	10
16	Course portfolio	Nil
	Total (100)	**100**

Syllabus

Introduction to Algorithms, Hardware Overview, Python as a Tool, Installing Python and Writing a Program, Variables & Expressions, Decision Statements, How to Debug?, Control Structures: Loops & Iterations, Linear Data Structure: String, List, Tuple, Data Dictionary and Set, Python Library (Pandas, Numpy, PyPlot), Functions, Classes & Objects, Working with Files

Matrix Operations, Eliminations, Matrix Inversion, Transformation, Solution of Linear , Simultaneous Equation, Eigen Values & Eigen Vectors , Linear Transformation, Linear Combination, Vector Spaces and Subspaces

Probability, Baye's Rule, Sampling, Data Processing and Pre-processing, Random Variable, Discrete & Continuous Distribution, Hypothesis Formulation , Test of Hypothesis, ANOVA, Correlation, Curve Fitting, Regression

Reference Books

1. Allen B. Downey. Think Python. Green Tea Press, Massachusetts, USA.
2. Kenneth Hoffman and Ray Kunze. Linear Algebra. PHI Learning Private Limited, 2nd Edition, 2012.
3. Gilbert Strang. Introduction to Linear Algebra. Wellesley-Cambridge Press, 4th edition, 2009.
4. Allen B. Downey. Think Stats. Green Tea Press, Massachusetts, USA.
5. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley & Sons, Inc., 3rd Edition (2004).
6. Rishard A. Johnson, Miller and Freund's probability and Statistics for Engineers, PHI

Course Title and Course Code	**Design and Prototyping (ES1102)**
Hours per Week	**L T P: 6 0 0**
Credits	**6**
Students who can take	**B. Tech Semester-I (Batch: 2019-2023)**

Objective of the course:

The students will be trained to analyze an unknown situation through critical thinking and formulate it into a known problem so that solutions can be found. Once solution found, student will be able to use engineering tools to convert a conceptual product into a real product.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Approach design challenges from the perspective of the user and offer innovative solutions effectively.
2. Communicate and work in team towards a common goal.
3. Think creatively towards a fun based, desirable solution.
4. Develop the projection views of the products with dimensions and scales.
5. Create the schematic diagram and isometric view of the parts using AutoCAD.
6. Fabricate prototype by combining the different parts.

Prerequisites		**Basics of Physics**
Sr. No	**Specifications**	**Marks**
1	Attendance	NIL
2	Assignment	30
3	Class Participation	NIL
4	Quiz	10
5	Theory Exam-I	NIL
6	Theory Exam-II	NIL
7	Theory Exam-III	NIL
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	50
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	NIL
16	Course Portfolio	NIL
Total (100)		**100**

Contact hours 78 (18+60)

Syllabus of Design Thinking & Prototyping 18hrs

1. Empathy

   Design thinking is a user-centered design process, and the empathy that comes from observing users enables design thinkers to uncover deep and meaningful needs (both overt & latent). Empathy, by definition, is the intellectual identification with or vicarious experiencing of the feelings, thoughts or attitudes of another. Three main techniques are used to gain empathy: interviewing, observation, immersion. The goal of the empathy mode is to discover gaps in between what people do and what people say they do. These gaps are the design opportunities.

   a. User Experience (On ground experience)
   b. Market Research
   c. Benchmarking, Competitor or Comparative Study
   d. Personal Experience (of the Designer)
   e. Analysis
   f. Revisiting the brief, make amendments (if brief is given by the client)

2. Define

   The Define mode is seen as a 'narrowing' part of the process. After collecting volumes of user information, it is time to distill down to one specific user group, their need and the insight behind that need so as to unify and inspire a team. The goal of this mode is to come up with at least one actionable problem statement (often referred to as Point of View (POV)) that focuses on the insights that you uncovered from real users**.**

   a. How to create a brief
   b. Setting parameters

3. Ideate

   Ideation is the process of idea generation. Mentally it represents a process of "going broad" in terms of concepts and outcomes. Ideation provides the fuel for building prototypes and driving innovative solutions.

   a. Brain storming
   b. Mood Board and Theme Development
   c. Concept Sketches(doodling) and Design Proposals
   d. Final Sketches and Blueprints
   e. Logistics, Material and Production feasibility check

4. Prototyping or Mock-up models

   Prototyping is the iterative development of artifacts – digital, physical, or experiential – intended to elicit qualitative or quantitative feedback. The act of prototyping implies "building", testing, and iterating and is, itself, both a flaring and a narrowing process. The flaring represents the proliferation of low-resolution prototypes developed as different aspects of the prototype are evaluated. The narrowing represents the refinement of the lower resolution models into increasingly complex and resolved

models based on feedback, which leads to an even better understanding of the user's needs.

a. Small and quick working models
b. Scale 1:1 working prototypes

5. Product Testing , User Testing & Iterations and Changes

   The test mode is another iterative mode in which we place our low-resolution artifacts in the appropriate context of the user's life. In regards to a team's solution, we should always prototype as if we know we're right, but test as if we know we're wrong—testing is the chance to refine our solutions and make them better.

   a. Testing the product on field
   b. Making relevant changes

Course Title and Code : Scientific Perspectives AS1102	
Hours per Week	**L-T-P: One week**
Credits	**2**

Course Objective: This course aims to develop scientific temper in students and also improve their understanding of basic science fundamentals and their applications in industry and research.

After course completion, the student will be able to:

1. Distinguish between science, pseudo-science and other forms of knowledge.
2. Distinguish between science, engineering, technology and mathematics and also identify the opportunities for integrating these disciplines.
3. Use the scientific approach to identify and understand the societal problems
4. Explain, Design and carry out Scientific studies

	Prerequisites	
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	Nil
3	Class Participation	10
4	Quiz	20
5	Theory Exam-I	Nil
6	Theory Exam-II	30
7	Theory Exam-III	Nil
8	Report-I (poster)	25
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	Nil
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I (Contus.)	Nil
15	Lab Evaluation-II (exam)	15
16	Course Portfolio	Nil
	Total (100)	**100**

Evaluation Scheme for Retest		
Sr. No	**Specifications**	**Marks**
1	Theory Exam-II	30

Syllabus

The philosophical aspects of scientific activity, Introduction to the Philosophy of Science, What is a "scientific theory"? ; The structure of a scientific theory, the methodology used to obtain scientific knowledge, Requirements to achieve scientific results, Methodology of experiment in

engineering studies, the purpose and structure of the experiment, Planning, Analysis of the results, some selected seminal scientific studies.

Reference Books:

1) The Scientific Approach: Basic Principles of the Scientific Method by Carlo L. Lastrucci, Schenkman Publishing, 1963
2) Trends in Bibliometrics and Scientometrics Studies by Praveen Kumar Jain, Jean-Charles Lamirel, Parveen Babbar, Athena Academic, 2017
3) The Evaluation of Research by Scientometric Indicators by Peter Vinkler, Chandos Publishing
4) John Stuart Mill's Philosophy of Scientific Method by John Stuart Mill; Ernest Nagel Hafner Press, 1950
5) Logic, Inductive and Deductive: An Introduction to Scientific Method by Adam Leroy Jones Henry Holt, 1909
6) The Path of Science by C. E. Kenneth Mees; John R. Baker John Wiley & Sons, 1946
7) The Logic of Scientific Discovery by Karl R. Popper Basic Books, 1959
8) Failure: Why Science Is So Successful by Stuart Firestein Oxford University Press, 2016

Course Title and Code: Critical Thinking & Power of Storytelling CC1102	
Hours per Week	**L-T-P: 2-1-0**
Credits	**2**
Students who can take	**B. Tech Semester-II (Compulsory)**

Course Objective:

The modern world offers confounding opinions and choices that need to be navigated judiciously. This course explores frameworks and processes to critically examine narratives, reconstruct them, and craft well-reasoned stories that can be told using impactful communication.

On successful completion of this course, the student should be able to:

1. Formulate intelligent questions to investigate.
2. Evaluate information and argument for correctness, consistency, relevance and validity.
3. Compose well-structured and well-reasoned arguments.
4. Articulate and evaluate the impact of narratives.
5. Distinguish between facts, assumptions and opinion.

Evaluation Scheme

Sr. No	**Specifications**	**Pre-Covid Scheme**	**Post-Covid Scheme**
1	Attendance	Nil	Nil
2	Assignment	20	30
3	Class Participation	20	20
4	Quiz	Nil	Nil
5	Theory Exam-I	Nil	Nil
6	Theory Exam-II	Nil	Nil
7	Theory Exam-III	40	30 (10% weightage to MOOC course)
8	Report-I	20	20
9	Report-II	Nil	Nil
10	Report-III	Nil	Nil
11	Project-I	Nil	Nil
12	Project-II	Nil	Nil
13	Project-III	Nil	Nil
14	Lab Evaluation-I	Nil	Nil
15	Lab Evaluation-II	Nil	Nil
16	Course Portfolio	Nil	Nil
	Total (100)	**100**	**100**
Evaluation policy for retest			
1	Theory Exam III	30	

Syllabus:

I. **Introduction to Critical Thinking**- Definitions of Critical Thinking, its applications and the methods to think critically. Paul & Elder model will be used.

II. **Importance of questioning**-The key to critical thinking is the ability to formulate intelligent questions. Students will be able to create, improve and prioritize their questions. They will be able to use different types of question by using Bloom's taxonomy to understand the root of any situation, problem or subject.

III. **Examine data Critically**-Students will be able to filter information, separate fact from opinion, identify cognitive biases and become aware of the ladder of inference. They will also be taught to conduct responsible research and basics of bibliography and citation.

IV. **Construct and reconstruct argument-** Students will be taught to construct arguments with sound reasoning. They will be able to support their claims and opinions with compelling data and facts, and present well-informed arguments. Evaluate argument using logical fallacies.

V. **Building a compelling Narrative-** Stories that we create and narrate influence how we see ourselves and our association with others. The students will be able to observe, think, create and narrate their stories in an effective manner.

Text and Reference Books:

1) Fisher, A. (2011). Critical thinking: An introduction. Cambridge University Press.
2) Fisher, A., & Scriven, M. (1997). Critical Thinking. Its definition and evaluation.
3) Dobelli, R. (2013). The art of thinking clearly: better thinking, better decisions. Hachette UK.
4) Budden, L. (2007). Critical Thinking Skills: Developing Effective Analysis and Argument. Contemporary Nurse, 25(1-2), 174-175.
5) Butterworth, J., & Thwaites, G. (2013). Thinking skills: Critical thinking and problem solving. Cambridge University Press.

Course Name: Object Oriented Programming
Course Code: CS1101 **L-T-P: 1-0-4**
Credits: 3

Course Description: This course teaches object oriented programming to those who have learnt basic programming concepts and are ready to learn in-depth programming. It focuses on object-oriented programming using JAVA. The main concepts are: Classes, Objects, Data Abstraction, Data Encapsulation, Overloading, Overriding, Polymorphism, Inheritance, Interfaces, Exception Handling, and Database Connectivity. This course also covers basic concepts for software design and reuse.

Learning Outcome:
On successful completion of this course, the students should be able to:

1. Develop Java Programs with the concepts of primitive data types, strings and arrays.
2. Develop Java Programs using Object Oriented Programming Principles such as Classes, Objects, Data Abstraction, Data Encapsulation, Overloading, Overriding, Polymorphism, Inheritance, and Interfaces.
3. Design, develop and debug programs in Core Java using coding and documentation standards.
4. Incorporate exception handling in Java Programs.
5. Use JDBC API connectivity in between Java Programs and database.

***NOTE:* Integrated Development Environments (IDEs) to be used in this Course are Eclipse or NetBeans – Both are compatible for Object Oriented Programming using Java.**

Basics of Java & Decision Statements - Introduction to Java**:** Features of Java, Byte Code and JVM, JDK, JRE; Data types and Operators: Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Datatypes, ADT, Operator types and precedence, Statements and Flow Control: Conditional statements, looping, return, etc., Abstract data types and their specification. How to implement an ADT. Concrete state space, concrete invariant, abstraction function.

Control Structures, Methods & Constructors - Object Oriented Programming in Java: Object Life time & Garbage Collection.

Methods & Constructors - Constructor & initialization code block, Parameterized Constructor, Loops, Methods.

Array & String - Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array, Operation on String, Mutable & Immutable String, Collection Bases Loop for String, tokenizing a String, Creating Strings using StringBuffer.

OOP's Concept I - Class Fundamentals, Object & Object reference, Access Control, Modifiers, Methods in Java: Method Declarations, Method Signatures, Invoking Methods,

OOP's Concept II - Static vs. Instance Data Fields, Static vs. Instance Methods, Method Overloading, Encapsulation.

Inheritance, Composition, and Aggregation, Invoking Base Class Constructors, Overriding vs. Overloading, Polymorphism Overloading.
Interfaces - Inner Class & Anonymous Classes, Abstract Class, Interface**s.**

Exception Handling - Introduction to Exception handling.

JDBC Programming - The JDBC Connectivity Model, Database Programming: Connecting to the Database, Creating a SQL Query, Getting the Results, and Updating Database Data.

Prerequisites		**Object Oriented Programming**
Teaching Scheme (Hours per Week)		1-0-4
Credits		3
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	NIL
2	Assignment	10
3	Class Participation	5
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	25
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	10
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
	Total (100)	**100**
Evaluation Scheme for Retest		
	Theory Exam-III	25
	Lab Evaluation-II	10
	Total	**35**

References

1. Liang, Y. Daniel. Introduction to Java programming: comprehensive version. Pearson Education, 2018.
2. Horstmann, Cay S., and Gary Cornell. Core Java 2: Volume I, Fundamentals. Pearson Education, 2016.
3. Schildt Herbert. The Complete Reference, Java 2, Fourth Edition. TMH, 2017.

Course Title and Code Python Programming CS1301	
Hours per Week	**L-T-P: 1-0-2**
Credits	**1**
Students who can take	**B. Tech CSE Semester II (IBM Specialization)**

Course Objective:

The aim of the course is to build up a clear understanding of the fundamentals of Python programming. The course will discuss and cover the topics necessary for the students to write and execute the programs on their own.

On successful completion of this course, the student should be able to:

1. Design and program the standalone Python applications.
2. Use lists, tuples, and dictionaries in Python programs.
3. Identify Python object types.
4. Design structure and components of a Python program.
5. Use Python Control and Decision-making Structures for writing programs
6. Write long iterative programs into recursive code.
7. Build programs that related to text analytics.
8. Build small graphics and animation programs.
9. Design machine learning model to perform data analysis.
10. Build own Python packages or modules for reusability.
11. Read and write files in Python.
12. Use Data Handling Techniques of Python
13. Use exception handling in Python applications for error handling, find syntax errors

Evaluation Scheme

Sr. No	**Specifications**	**Pre-Covid Scheme**	**Post-Covid Scheme**
1	Attendance	Nil	Nil
2	Assignment	20	30
3	Class Participation	10	Nil
4	Quiz	Nil	20
5	Theory Exam-I	Nil	Nil
6	Theory Exam-II	15	Nil
7	Theory Exam-III	25	Nil
8	Report-I	Nil	Nil
9	Report-II	Nil	Nil
10	Report-III	Nil	Nil
11	Project-I	Nil	Nil
12	Project-II	Nil	Nil

13	Project-III	Nil	Nil
14	Lab Evaluation-I	15	25
15	Lab Evaluation-II	15	25
16	Course Portfolio	Nil	Nil
	Total (100)	**100**	**100**
Evaluation policy for retest			
1	Theory Exam-III	25	Nil
2	Lab Evaluation-I	Nil	25
3	Lab Evaluation-II	15	25
	Total	**40**	**50**

Syllabus:

Fundamentals of Python: Beginnings with Python, Parts of a Program: Modules, Statements and Expressions, Whitespace, Comments, Special Python Elements: Tokens, Naming Objects, Variables, Objects and Types, Operators;

Control: The Selection Statement for Decisions: if,

Repetition: for Statement, In-Depth Control: Boolean Variables, Relational Operators, Boolean Operators, Precedence, while Statement, Nesting, Recursion;

Functions: What Is a Function? Python Functions, Flow of Control with Functions, Scope, Arguments, Parameters, and Namespaces, Default Values and Parameters, Functions as Objects;

Files and Exceptions: What Is a File?, Accessing Files: Reading Text Files, Accessing Files: Writing Text Files, Reading and Writing Text Files in a Program, File Creation and Overwriting, Handling Errors: Error Names, The try-except Construct, try-except Flow of Control, Exception;

Strings: The String Type, String Operations, Formatted Output for Strings;

Lists and Tuples: What Is a List? Iteration, Indexing and Slicing, Operators, Lists vs Strings, Split and Other Functions and Methods, Anagrams, Tuples from Lists, Python Diversion: List Comprehension;

Dictionaries and Sets: Dictionaries, Python Dictionaries, Dictionary Indexing and Assignment, Sets, Python Sets, Methods, Operators, and Functions for Python Sets, Set Methods;

Introduction to *Classes*: Object-Oriented Programming, Characteristics of OOP, Class and Instance, Object Methods, Fitting into the Python Class Model, Python and OOP, Python and Other OOP Languages, Classes, Types, and Introspection, Inheritance

Reference Books:

1. William Punch, Richard Enbody, 'The Practice of Computing Using Python'. Pearson, 2016
2. 'Python Training Module'. IBM Academic Initiative, (2019).

Course Title and Code	Calculus and Applied Mechanics ES1103
Hours per Week	**L-T-P: 6-2-0**
Credits	**6**
Students who can take	**B. Tech Semester-II (Compulsory)**

Course Objective:

This course introduces the basic elements of calculus and mechanics through some engineering projects. The application of multivariable calculus in civil and mechanical engineering is also highlighted. This course will equip students with essential domain knowledge of calculus and applied mechanics in solving basic engineering problems.

On successful completion of the this course, the student should be able to:

1. apply analytical techniques to determine forces in structures
2. use commercial software(STAAD Pro.) to simulate a structure/frame and determine force in the members
3. model physical phenomena using calculus and solve using appropriate method
4. apply Newton's laws of motion and understand the concepts of dynamics concepts (force, momentum, work and energy)
5. interpret the geometrical significance of differential and integral calculus
6. solve problems of vector differentiation and integration
7. calculate the buoyant forces of objects with various shape and carryout the stability analysis
8. apply the concept of partial differentiation to solve optimization problems

Evaluation Scheme:

Sr. No	**Specifications**	**Old Scheme Marks**
1	Attendance	--
2	Assignment	10
3	Class Participation	5
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	30
8	Report-I	--
9	Report-II	--
10	Report-III	--
11	Project-I	15
12	Project-II	15
13	Project-III	--
14	Lab Evaluation-I	--

15	Lab Evaluation-II	--
16	Course Portfolio	--
	Total (100)	**100**
Provision of re test		
1	Theory Exam-III	**30**

Syllabus:

Vectors Algebra: basics of vector algebra, resultant vector, Application of vector equilibrium on structures.

Force systems basic concepts, equilibrium of system of forces, free body diagrams, equations of equilibrium of coplanar systems, structures (trusses), analysis of structures, method of joints, method of section, friction, virtual work, work energy principle, impulse-momentum (linear, angular).

Function of several variables, functions of one and several variables, partial differentiation, maxima-minima.

Vector Differentiation: Vector functions and derivatives, Arc length and unit tangent vector, Curvature and unit normal vector, Directional derivative and gradient vectors, Tangent plane, Divergence and curl of a vector field

Integral Calculus, area under curve, arc length, double integral, change of order and triple integrals, surface and volume integrals, solids of revolution, moment of inertia, floatation, buoyancy, centroid

Vector Integration: Line integral, flux, work done, circulation, path independence, potential function and conservative fields, Surface area and surface integral, Green's theorem in the plane, Stoke's theorem, Divergence theorem

Text Books:

1. M.D. Weir and J. Hass, Thomas, Calculus, Pearson, India, 2016.
2. R.C Hibbeler, Engineering Mechanics, Pearson India, 2010.

Reference Books:

1. Goldstein et. al., Calculus and Its Applications, Pearson, India, 2018.
2. SS Bhavikatti, Engineering Mechanics, New Age International Publishers, 2019.
3. Beer and Johnston, Vector mechanics for engineers, McGraw Hill Education, 2009.
4. S Timoshenko, Engineering Mechanics, McGraw Hill Education, 2017.
5. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley, India, 2013.
6. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, New Delhi, India, 2015.

Course Name: Fundamentals of Automation Engineering (ES1111)

Automation engineers design, program, simulate and test automated machinery and processes. This course is aimed at building key technical competencies needed by automation engineers. It is focused on basic knowledge and critical understanding of different technologies in the design and maintenance of automation systems.

General Learning Outcomes

On successful completion of this course, the students should be able to:

1) propose and implement a complete solution for a simple automation problem, including power supply, actuator, sensor, data acquisition and control, sensitized with energy usage and effects on environment.
2) evaluate the benefits and challenges of automation technologies
3) explain the importance of adopting suitable engineering standards for automation projects
4) apply good management practices for automation projects

Unit-specific Learning Outcomes

Unit 1 Introduction to Electrical Engineering – U1

1. Analyze electrical circuits using network theorems
2. Measure electrical parameters of passive as well as active electrical components
3. Design rectifier circuit using semiconductor devices.
4. Design filters for power conditioning.
5. Design and test a linear power supply for given specifications
6. Design and build Printed Circuit Boards.
7. Use electrical safety practices while working on electrical projects.

Unit 2 Introduction to Automation Engineering and Control Systems – U2

1. Formulate mathematical models for basic electro-mechanical systems
2. Design and simulate a basic analog open-loop control system

Unit 3 Introduction to Digital Circuits – U3

1. Evaluate and simplify Boolean functions and implement the minimized logic using logic gates.
2. Implement and test basic combinational and sequential circuits with minimum complexity
3. Implement various logic functions using software programming with micro controller, so as to make optimal utilization of resources.
4. Identify the key features of embedded systems in terms of hardware and software
5. Interface sensors and design low power embedded systems projects using microcontroller

NOTE: The following information is only valid for semester September 2020 – January 2121. On-line mode due to COVID-19.

Teaching Scheme and Credits

Hrs. per Week		Credits	Duration in Weeks
In Class	Out Class	3	12
2 (L) + 0(T) +2(P)	2		

Expectations from the Students:

1. To be punctual at sessions and be interactive during discussions
2. To dedicate 2 hours a week for this course (for self-study and assignments)
3. To demonstrate teamwork by contributing to the overall success of the project.
4. To seek prior concern from instructor(s) is required for absentees.
5. Academic integrity is expected from students.
6. To take notes using two notebooks: one for theory and one for activities/practicals
7. Each group must maintain a Project Folder, updated with diagrams, calculations, equations, code, etc.

Expectations from the Faculty Members:

1. To assess student progress by continuous evaluation and provide feedback to students on their performance, fortnightly.
2. To help students to update on latest automation technology used in industry and develop new project ideas.

Course Feedback: Online Every Fortnight

Evaluation Scheme

Sr. No	Specifications	Marks
01	Assignment	10
02	Quizzes	10
03	MID TERM Theory Exam	15
04	END TERM Theory Exam	20
05	Report -1	Included with Project 1
06	Report-2	Included with Project 2
07	Project -1	10
08	Project -2	10
09	Lab Evaluation (Continuous)	15
10	Lab Evaluation (Exam)	10
	Total (100)	**100**

Project Evaluation Components –

Design	Skills demonstrated	Time Mgmt.	Sophistication/ neatness in work	Presentation	
				Presentation Skills	Viva
(20%)	(20%)	(10%)	(20%)	(20%)	(10%)

Syllabus:

Digital circuits for automation: Boolean Algebra, Karnaugh map, Logic gates, Decoders and Multiplexers, Sequential Circuits, Displays, Sensors and Microcontrollers for automation: Working principle of sensors. Architecture of ATMega328 (concepts on ALU, memory, ports). Applications on sensors interfacing with microcontroller.

Project: The course leads to developing a digital measurement system for the device developed in course Design and Prototype.

Professional Skills: Team-work, Leadership, Professionalism, Time Management, Presentation skills, Communication Skills, Technical Report

Reference Books:

1. Digital Logic and Computer Design Fundamental by Morris Mano, Pearson Publication, 5th Edition.
2. Programming and Customizing the AVR Microcontroller by Dhananjay Gadre, 1st Edition, Mc Graw Hill Publication, ISBN-13: 978-0071346665

IT Resources

https://nptel.ac.in/courses/108/105/108105132/

Course Title and Code: Energy and Environment Studies ES1105	
Hours per Week	**L-T-P: 1-0-0**
Credits	**2**
Students who can take	**B. Tech Semester-II (Compulsory)**
Course Objective: To enhance the understanding of conventional and non-conventional energy sources and its relationship with the ecology and environment.	
On successful completion of this course, the student should be able to: 1. Relate renewable energy with ecology & environment 2. Explain the climate change and threat to biodiversity 3. Describe the various pollution sources and their impacts on Environment	

Evaluation Scheme

Sr. No	**Specifications**	**Pre-Covid Scheme**	**Post-Covid Scheme**
1	Attendance	NIL	Nil
2	Assignment	20	20
3	Class Participation	10	10
4	Quiz	10	10
5	Theory Exam-I	NIL	Nil
6	Theory Exam-II	25	Nil
7	Theory Exam-III	35	20
8	Report-I	NIL	20
9	Report-II	NIL	20
10	Report-III	NIL	Nil
11	Project-I	NIL	Nil
12	Project-II	NIL	Nil
13	Project-III	NIL	Nil
14	Lab Evaluation-I	NIL	Nil
15	Lab Evaluation-II	NIL	Nil
16	Course Portfolio	NIL	Nil
	Total (100)	**100**	**100**
Evaluation policy for retest			
1	Theory Exam III	30	

Syllabus (Theory):

Unit-1: Present Energy resources in India and its sustainability, Energy Demand Scenario in India- Advantage and Disadvantage of conventional Power Plants – Conventional vs Non-conventional power generation.

Unit-2: Basics of Solar Energy, Wind energy- Environmental benefits and impacts, Biomass resources- Bioenergy, Geothermal Energy.

Unit-3: Understanding environment, global crisis, Basic Concepts Forest and Grassland ecosystems, Desert Ecosystems, Aquatic Ecosystems Introduction to Biodiversity, Biodiversity Conservation.

Unit-4: Air pollution- Sources, effects, control, air quality standards, air pollution act, air pollution measurement. Greenhouse gases – effect, Global Warming, Acid Rain, and Ozone Depletion, Water pollution-Sources and impacts, Noise pollution, Soil pollution, Pollution aspects of various power plants.

Reference:

1) Rajagopalan, R., "Environmental Studies: From Crisis to Cure", Oxford **University Press, New Delhi, 2e, 2011**
2) Ranjit Daniels & J. Krishnaswamy "Environmental Studies", Wiley India
3) Davis & Cornwell "Environmental Engineering", McGraw Hill
4) Gilbert M. Masters and Wendell P. ELA – Introduction to Environmental Engineering And Science
5) W. Cunningham – Principles of Environmental Science, TMH
6) P. Venugoplan Rao – Principles of Environmental Science and Engineering, PHI.
7) Meenakshi – Environmental Science and Engineering, Prentice Hall India.
8) Martin – Ethics in Engineering, TMH

Video Lectures:

1) http://www.nptelvideos.in/2012/12/fundamentals-of-environmental-pollution.html
2) http://www.nptelvideos.in/2012/11/energy-resources-and-technology.html
3) https://nptel.ac.in/courses/122/102/122102006/
4) https://nptel.ac.in/courses/127106004/

Websites (related to the course)

1) http://www.cpcb.nic.in/
2) http://www.rpcb.rajasthan.gov.in
3) http://www.bis.org.in/
4) http://www.who.int/en/
5) http://www.moef.gov.in/

Course Title and Course Code	**MATERIALS ENGINEERING (ME1101)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-III (Batch: 2018-2022)**

Course Objective:

The main objective of the course is to impart knowledge of materials engineering so that students can able to identify crystal structure, crystal defects, select suitable material for application based components, and control their mechanical properties.

Learning Outcomes:

On successful completion of this course, the students will be able to:

1. Identify crystal structure, crystal defects and perform various mechanical tests as per ASTM standards to know properties of materials.
2. Evaluate materials on the basis of their static and dynamic failure criteria as per ASTM standards.
3. Perform various heat treatment processes to hold required mechanical properties in ferrous alloys.
4. Prioritize other ferrous and non-ferrous alloys for various applications.

Prerequisites		**Basics of Physics**
Sr. No	**Specifications**	**Marks**
1	Attendance	5
2	Assignment	10
3	Class Participation	NIL
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	20
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**

COURSE SYLLABUS (Theory):

UNIT - I

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics.

Imperfection in Solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. **(6)**

Mechanical Property Measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery;

Hardness: Rockwell, Brinell and Vickers and their relation to strength. **(6)**

UNIT - II

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb;

Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion.

Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to nondestructive testing (NDT) **(8)**

UNIT - III

Phase Diagram: Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron. **(6)**

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening. **(6)**

UNIT - IV

Ferrous and Non Ferrous Alloys: Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based super-alloys and Titanium alloys **(8)**

COURSE SYLLABUS (Practical):

1. To evaluate microstructure of various metallic materials and prepare a comparative report.
2. To perform Tensile Test and know the tensile properties of the metallic materials
3. To perform Impact Test and know about the toughness of the metallic materials

4. To perform Hardness Test and know about the hardness value of the metallic materials
5. To perform Torsion Test on the metallic materials and calculate torsional rigidity of the materials.
6. To perform Fatigue Test on the metallic materials
7. To perform Compression Test on the metallic materials
8. To perform and compare various Heat Treatment (Anealing, Normalizing, Quenching) cycles.
9. To perform Heat Treatment cycle to understand Case Hardening.
10. Study of various ferrous and non-ferrous materials
11. Effect of strain rate on various properties of materials

Text Books:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

Course Title and Code: Computational Engineering Analysis – I (ES1106)	
Teaching Scheme	**L-T-P: 3-1-2**
Credits	**5**

Course Objective

The course will cover the basic components of Ordinary Differential Equations (ODE), Complex analysis and Laplace transforms and modelling & simulation of various problems in engineering discipline. Few numerical methods will be introduced to find the numerical solutions of various problems. Various domain specific Engineering problems will be discussed and appropriate simulation tools will be used for solving them.

Learning Outcomes:

On successful completion of this course, the students will be able to:

1. Solve ordinary differential equations through various techniques.
2. Determine the structural behavior of the body by determining the stresses, strains produced by the application of load.
3. Analyze the concept of buckling and be able to solve the problems related to column and struts.
4. Model the problems of column and struts mathematically in terms of ordinary differential equations and solve them using the appropriate method.
5. Simulate the solutions of the above mentioned models of columns and struts.
6. Analyze a function of complex variables in terms of analyticity, poles and zeroes.
7. Find Laplace and inverse Laplace transforms of given function and use Laplace transform to solve ordinary differential equations.
8. Design and Evaluate the LC, RC & RL Networks using Foster'sand Cauer Forms
9. Analyze stability criteria for electrical network using pole zero plot and routh-hurwitz polynomials
10. Model and simulate electrical networks using Proteus simulator/ Virtual lab.

Prerequisites		**Nil**
Sr. No	**Specifications**	**Marks**
01	Attendance	NA
02	Assignment	NA
03	Class Participation	10
04	Quiz	20
05	Theory Exam I	20
06	Theory Exam II	NA
07	Theory Exam III	30
08	Report-1	NA
09	Report-2	NA

10	Report-3	NA
11	Project -1	NA
12	Project -2	NA
13	Project -3	NA
14	Lab Evaluation-1	10
15	Lab Evaluation-2	10
16	Course portfolio	NA
	Total (100)	100
Evaluation Scheme for Re-Test		
1	Theory Exam-III	30
	Total	30

Syllabus

ODE: Ordinary differential equations of first order and first degree, higher order ODEs with constant coefficients, Differential equation of second order with variable coefficients, Numerical solution of ODEs.

Applications of ODE in structural analysis : column and struts - Definitions, Classifications, Assumptions made in the Euler's Column Theory, Expressions for crippling load of different cases like both the ends are hinged or pinned, one end is fixed and other is free, both ends are fixed, one end is fixed other is hinged, Effective length of column, Slenderness ratio, Crippling stress in terms of Effective length and radius of gyration, limitations of Euler's Formula, Rankine's Formula, Eccentric loading, Johnson's Formula for Columns, both straight line and parabolic formula for columns.

Functions of Complex variables: Complex numbers, complex conjugates, functions of complex variables, real and imaginary parts of a complex function, analytic functions, C-R equations, Poles and zeros of a complex function, Taylor's theorem and Taylor's expansion.

Laplace transform: Basic Laplace transform and inverse Laplace Transforms, solution of ODEs using Laplace transform, solution of system of ODEs using Laplace transform.

Network Functions: Concept of complex frequency, transform independence, network functions of one and two port network, concepts of poles and zeros, properties of driving point and transfer functions, time response stability from pole zero plot, Routh-Hurwitz polynomials.

Network Synthesis: Positive real functions, Basic syntheses procedure, method of syntheses, driving point syntheses of one port network (R-L and R-C and R-L-C).

Transient Analysis: Modeling of Resistors, Inductors, capacitors, operating temperature, transient sources and transient output variables. Complete response of RL, RC, and RLC circuits to step, sinusoidal, exponential, ramp, impulses and the combinations of excitations. Initial value and final value theorem.

Textbook:

1. Advanced Engineering Mathematics, Erwin Kreysig, Wiley, India.
2. Hibbeler, R.C., “Mechanics of Materials”, 6th SI edition, Prentice Hall

References:

1. Thomas’ Calculus, M.D. Weir and J. Hass, Pearson.
2. Engineering Mathematics, Srimanta Pal and Subodh C. Bhunia, Oxford University Press, New Delhi, India.
3. Higher Engineering Mathematics, B.V. Ramana, Mc Graw Hill Education.
4. T.K.Nagsarkar,M.S. Sukhija,”Basic Electrical Engineering”, Oxford University press, 2nd edition, 2011.
5. Roy Choudhary, “Network Theory”, TMH, 3rd Edition, 2004.
6. Edminister Joseph A., “Electrical Circuits, Schaum’s Outline Series”, Tata McGraw Hill, 3rd edition, 2012.
7. Hayt W.H., Kemmerly J. E., Durbin S. M., “Engineering Circuit Analysis”, Tata Mcgraw Hill, 6th edition, 2006.
8. Beer, F.P., Johnston, E.R., DeWolf, J.T., “Mechanics of Materials”, 4th edition, McGraw Hill. Craig, R.R., “Mechanics of Materials”, 2nd edition, John Wiley and Sons.

Course Title and Course Code	**Engineering Measurements and Machine (ES1107)**
Hours per Week	**L T P: 3 0 4**
Credits	**5**
Students who can take	**B. Tech Semester-III**

Course Objectives:

The aim of this course is to impart the knowledge of mechanical and electrical machine used in industries. Students will learn the fundamental of engineering principles governing the engineering process and its use in real-world. Students will get the knowledge of sensors, actuators and its selection process for any industrial application.

Learning Outcomes:

On successful completion of this course, the students be able to:

1. Evaluate suitable electrical and non-electrical instruments for measuring physical quantities.
2. Analyze the construction, characteristics and applications of various types of rotating machines.
3. Analyze the working of any mechanical and electrical machine using mathematical model.
4. Integrate the sensors for monitoring and automation of electrical and mechanical systems.
5. Design electro-mechanical machines as per Indian standards.

Prerequisites	**Basics of Physics**

Evaluation Scheme

Sr. No	**Specifications**	**Marks**
1	Attendance	NIL
2	Assignment	10
3	Class Participation	5
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	20
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	10
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10

16	Course Portfolio (MOOC Course)	10
Total (100)		**100**

Evaluation scheme for Retest		**Marks**
1	Theory Exam	20
2	Lab Evaluation (Exam)	10
Total		**30**

Syllabus (Theory):

Unit-I: Measurement, Instrumentation and Calibration

Introduction, types of applications of measurement instrumentation, performance characteristics, error in measurements, calibration and standards, static and dynamic characteristics of instrument, Measuring Instruments, Digital meters, Function Generators, AC Bridges, Electronic Instruments for Measuring Basic Parameters.

Unit-II: Transducers

Classification of transducers, Selection of transducers, measurement of physical quantities, Elements of data acquisition system, Smart sensors.

Unit-III: Transformers

Construction, principle of operation, equivalent circuit, losses, testing, efficiency and voltage regulation, auto transformer, three phase connections, parallel operation of transformers, tap changing.

Unit-IV: Rotating Machines

DC Machines

Construction, EMF and torque equation, circuit model, armature reaction, methods of excitation, characteristics of generators, characteristics of motors, starting and speed control, testing and efficiency.

Induction Motors: Construction, working principle, classification and applications, equivalent circuit, Torque - slip characteristics, starting and Speed control of induction motors.

Unit-V: Mechanical Machines

Turbines: Introduction to steam turbines, Impulse and Reaction turbines, turbine power and related calculations.

Pumps: Introduction of pumps, centrifugal pumps, working of centrifugal pumps, Cavitation and its effect on pump, working of reciprocating pumps, Application of pumps in industries.

Power Transmission Systems: Mechanical drives and their performance analysis.

List of Experiments:

Measurement

1. To Determine Output characteristics of LVDT and Measure of Displacement Using LVDT.
2. Measurement of Inductance using Maxwell's bridge.
3. Measurement of earth resistance by earth tester and measurement of Insulation resistance by Megger.

Electrical Machines

1. To perform Ratio, Polarity and Load test on a single-phase transformer.
2. To perform open circuit and Short circuit test on a single-phase transformer and hence determine its equivalent circuit parameters.
3. To find the relation between open circuit voltage and field current of:
   (i) Separately excited DC generator, (ii) Self excited DC shunt generator
4. Speed control of DC shunt motor: (i) By varying field current with armature voltage constant. (ii) By varying armature voltage with field current kept constant.
5. To perform No load and blocked rotor test on a three-phase Induction Motor, and hence determine its equivalent circuit parameters.

Mechanical Machines

1. To study the performance of turbines used in steam power plant
2. To study the performance of belt drive system used for power transmission.

Text Books:

1. H S Kalsi, Electronic Instrumentation, McGraw Hill Education (India) Private Limited.
2. Nagrath I. J and Kothari D. P. 'Electric Machines', Tata McGraw Hill Publishing Company Ltd.
3. B. L. Theraja, and A. K. Theraja, Text of Electrical Technology, Vol -2; S. Chand Publication.
4. J B Gupta, Theory and Performance of Electrical Machines, S.K. Kataria and Sons.
5. Ashfaq Hussain, Electrical machines, Dhanpat Rai and Co.
6. P S Bimbhra, Generalised theory of rotating machines, Khanna Publishers.
7. R K Bansal, A Textbook of Fluid mechanics and Hydraulic machines, Laxmi Publication (P) ltd.
8. S S Ratan, Theory of Machines, Tata McGraw-Hill.

Reference Books:

1. Fitzgerald and C. Kingsley Jr., Electric Machinery, McGraw-Hill Book Co.
2. Chapman, Electric Machinery Fundamentals, The McGraw-Hill Companies, Inc.

Online sources:

Electrical Measurement and Electronic Instruments
https://nptel.ac.in/courses/108/105/108105153/

Sensors and Sensor Circuit Design

https://www.coursera.org/programs/j-k-lakshmipat-university-on-coursera-kzogk/browse?index=prod_enterprise_products&productId=487N_QqXEeeqsQo32tjRBA&productType=course&query=Sensor&showMiniModal=true

Electrical Machines

https://nptel.ac.in/courses/108/102/108102146/

Motors and Motor Control Circuits

https://www.coursera.org/programs/j-k-lakshmipat-university-on-coursera-kzogk/browse?index=prod_enterprise_products&page=3&productId=-i5RF2jdEeecwwoEvbWpsg&productType=course&query=Electrical+Machines&showMiniModal=true

Turbines and Pumps

https://nptel.ac.in/courses/112/103/112103249/

Power Transmission Systems

https://www.youtube.com/watch?v=3UaFeNm_ZF8

Course Title and Code: Engineering Thermodynamics ME1102	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	**B. Tech Semester-III (Core)**

Course Objective:

The objective of the course is to develop understanding of mass, energy, heat, work, efficiency, ideal and real thermodynamic cycles and processes. This also covers first and second laws of thermodynamics, perfect gas law, properties of real gases, and the general energy equation for closed and open systems.

On successful completion of the this course, the student should be able to:

1. identify the basic thermodynamic processes in our day to day life and industrial processes
2. judge the state of the pure substances such as compressed liquid, saturated liquid-vapor mixture and superheated vapour using property diagrams and tables.
3. apply the first law of thermodynamics to analyse the working of the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow
4. construct energy and mass balance for unsteady-flow processes.
5. assess thermodynamic applications using second law of thermodynamics to power and refrigeration cycle.

Sr. No	**Specifications**	**Marks**
1	Attendance	
2	Assignment	10
3	Class Participation	10
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	15
7	Theory Exam-III	25
8	Report-I	
9	Report-II	
10	Report-III	
11	Project-I	
12	Project-II	
13	Project-III	
14	Lab Evaluation-I	20
15	Lab Evaluation-II	
16	Course Portfolio	
	Total (100)	**100**

Syllabus:

Areas of Application of Thermodynamics, Different Approaches in the study of Thermodynamics, SI Units, Definitions and Concepts: System, Energy, Work; Thermodynamic equilibrium, Properties, Heat & Work, System, Surroundings, Types of Systems, Intensive and Extensive Properties, Energy, Macroscopic modes of Energy, Microscopic modes of Energy, Thermodynamic Equilibrium, Process, Work, Thermodynamic Definition of Work , Heat, Introduction to state postulate, Zeroth Law of Thermodynamics, Temperature Scale , Perfect Gas Scale .

First-Law of Thermodynamics and Analysis of Closed Systems: First Law of Thermodynamics, Heat is a Path Function, Energy is a Property of the System, A Perpetual Motion Machine of First Kind, Analysis of Closed Systems, Characterisation of Reversible Adiabatic Process, Polytropic Process, Ideal Gas Model.

First-Law of Thermodynamics for the Flow Processes: Conservation of Mass applied to a control volume, Conservation of Energy applied to a Control Volume, Steady State Flow Processes, Application of Steady State Flow Processes, Throttling Process, Application of Throttling Process .

Thermodynamic Properties of Pure Substances: Thermodynamic Properties of Fluids, Pure substance, Equations of State, Ideal Gas, Thermodynamic diagrams and tables, phase-Change Process of Pure Substances, Specific internal energy and enthalpy, Steam Tables.

Second Law of Thermodynamics, Entropy and Availbility: Limitations of First Law of Thermodynamics, Heat Engine, Heat Pump, Refrigerator, Kelvin Planck Statement, Clausius Statement of the Second Law, Reversibility, Irreversibility and Carnot cycle Carnot's Principles (Theorems), Thermodynamic Temperature Scale, Reversible Cycles and Clausius Inequality

Entropy: Concept of Entropy, Principle of Entropy Increase, calculation of entropy change. Temperature Entropy Diagram & Second Law Analysis of a Control Volume:Temperature Entropy Diagram, Second law analysis of a control volume, Steady-state steady-flow processes, TdS Equations, Entropy change of an incompressible substance, criterion of equilibrium, Thermodynamic definition of temperature, pressure and chemical potential, Thermodynamic potentials.

Availability & Irreversibility: Availabilty Function and Irreversibility: Introduction, Availability Function for a non-flow Process, Availability Function of Flow Processes, Irreversibility.

Power and Refrigeration Cycles: Introduction, Practical Rankine Cycle, Reheat Cycle (continuation of Rankine cycle), Regenerative Cycle, Binary Vapor Cycle. Introduction to Gas Power Cycles: Introduction, Air standard Otto Cycle, Air standard Diesel Cycle. Air Standard Dual Cycle, Comparison of Otto, Diesel & Dual Cycles, Air Standard Brayton Cycle. Reversed Carnot Cycle as a Refrigeration Cycle, Vapour Compression Cycle, Refrigerants, Absorption Refrigeration System, Heat Engine, Gas Refrigeration Cycle.

Thermodynamic Relations: Introduction, Important Mathematical Relations, Jacobian Method, Cyclic Rule, Maxwell Relations, Thermodynamic Relations involving Entropy Clapeyron Equations: Clapeyron Equations, Kirchhoff's equations, Change of Latent Heat with Temperature.

Text Books:

1. Yunus A Cengel, “Thermodynamics: An Engineering Approach” McGraw Hill Education; Eighth edition
2. PK Nag, “Engineering Thermodynamics” McGraw Hill Education
3. M. Achuthan, “Engineering Thermodynamics” Prentice-Hall of India

Reference Books:

1. P W Bridgman, “The Nature of Thermodynamics” Harvard University Press

Perspectives on Contemporary Issues
Course Code: CC1103
Credit: 2
L-T-P: 2-0-1
Course Description:
In an era of globalization, there is an increasing need for the youth to be able to empathize with others, value diverse perspectives and cultures and understand how events around the world are intertwined. Global issues revolve around social, economic and environmental factors which ultimately add to the interconnectedness of countries. In this course, students will employ key critical thinking concepts to analyze contemporary issues from multiple perspectives. They will explore the impact at micro and macro levels.

Course Outcomes:
The students will be able to:

- Identify different perspectives objectively.
- Explain interconnectedness of the issues and their impact at micro and macro levels.
- Recognize their own beliefs, biases, claims and assumptions.
- Evaluate sources, argue and defend effectively.

Teaching Pedagogy:
This course will be an amalgamation of brief lectures and activity based learning i.e. films, group discussions, debates, and case studies. The objective behind utilizing activity based learning is for the learners to have a more hands on experience. This will encourage and ensure active participation and longer retention. The idea is for learners to feel engaged and also express their views in a conducive environment. The takeaway from this course will not only be awareness about certain issues but equipping learners with skills of decision making and reasoning in alignment with certain global contexts.

Course Content:

- **Introduction to contemporary perspective**
- **Research, analysis & evaluation of a topic from local, national and global perspectives on:**
- **Climate Change and Sustainability**
  Understanding the magnitude of the issue, its impact and future challenges.
  How we can meet our current needs without diminishing the quality of the environment or reducing the capacity of future generations to meet their own needs.
- **Globalization**
  With increasing development throughout the world, the focus of this theme will be on the impact of globalization in India**.**
- **Nationalist Movement**

There is a sense that excesses of globalization have created an identity crisis across the world, facilitating the rise of nationalist movements. Rising nationalism is seen everywhere, from the election of Donald Trump to Brexit, the success of far-right parties in Italian, German and Austrian elections in 2017 and 2018, nationalism appears to be on rise globally. We will look at its reasons and implication**.**

- **Technology**
  Impact of unprecedented technological growth, challenges and opportunities.
- **Social justice and human rights**
  An understanding of the impact of inequality and discrimination, the importance of standing up for our own rights and our responsibility to respect the rights of others

Evaluation Scheme:

Sr. No	**Specifications**	**Weightage (%)**
01	Assignment	20
02	Class Participation	20
03	Theory Exam II	15
04	Theory Exam III	25
05	Report	20
	Total (100)	**100**

References for Reading:

1. Harari, Y. N. (2019). 21 Lessons for the 21st century. Toronto: CELA.
2. Guha, R. (2019). India After Gandhi: the history of the world's largest democracy. NEW YORK: ECCO.
3. Rosling, H., Rosling, O., & Rönnlund Anna Rosling. (2019). Factfulness: ten reasons were wrong about the world - and why things are better than you think. London: Sceptre.
4. Kolbert, E. (2015). The Sixth Extinction: An unnatural History. Bloomsbury

MANAGEMENT PERSPECTIVES (IL1101)

COURSE CREDITS: 2
SESSION DURATION: 60 MINUTES

COURSE DESCRIPTION:

The present course is an introductory and integrative action encapsulated course designed for the engineering students to introduce them to management discipline and the core functional areas contributing to it. This course adopts the integrated problem oriented approach via the use of cases and simulation. It implies that complex business problems, in the form of cases and simulations require students to understand different dimensions of the problem and come up with holistic solutions. The course will help students to be familiar with trending management issues and at the same time apply the knowledge gained.

LEARNING OUTCOMES
After completion of this course, the students will able to:

- Comprehend the importance of management and its functional areas in businesses and also its interaction with technology.
- Highlight specific external and internal issues impacting businesses.
- Integrate and analyze multiple dimensions of management aspects to solve business problems.
- Evaluate the aspects that management might consider when evaluating technical and engineering projects such as planning and scheduling, personnel management, cost control etc. from a management perspective

TOPICS TO BE COVERED:
HR

1. Business organization- Current challenges
2. HR and its growing importance.
3. Overview of people management systems
4. Recent trends shaping HR.

Economics:

1. Introduction of important concepts of Micro and Macro Economics
2. Key Features of Indian Economy
3. Understanding of economic environment of business

Marketing:

1. Marketing Process
2. Elements of Marketing Mix
3. Segmentation, Targeting and Positioning

Finance and Accounts:

1. Understanding Accounting Terms
2. Overview of Financial Reports, viz., Balance Sheet, Income Statement, Cash Flow Statement
3. Interface of Balance Sheet and Income Statements
4. Types of Costs and assessing and ascertaining Costs

BOOKS FOR REFERENCE

- Aswathappa, K. (2008) - Human Resource Management Text and Cases,Tata McGraw Hill New Delhi.
- Rao VSP (2002)– Human Resource Management, Text and Cases,Excel Book, New Delhi
- Armstrong, G. and Kotler, P. (2017). Marketing: An Introduction. New Delhi: Pearson Education.
- Ramaswamy, V. S., & Namakumari, S. (2013). Marketing Management: Global Perspective, Indian Context. New Delhi: Macmillan (India) Limited.
- T. R. Jain (Latest Edition). Economics for Engineers. New Delhi: V K Publications.
- Ramachandran N & Kakani K.Ram.(2017). How to Read a Balance Sheet,2/e. New Dehi: Mc Graw Hill Publications.
- Mott Graham. (2008). Accounting for Non-Accountants: A Manual for Managers and Students. Kogan Publication.
- Goyal, V.K. & Goyal, Ruchi. (2016). Financial Accounting, 4/e, New Delhi: PHI Learning Pvt. Ltd.[ISBN.-978-81-203-4626-0]

ASSESSMENT MATRIX

The criteria for assess the learning outcomes of this course are as follows:

S.No.	**Specification**	**Marks**
1	Attendance	**10**
2	Assignment	Nil
3	Class Participation	**10**
4	Quiz	Nil
5	Theory Exam-I	Nil
6	Theory Exam-II	Nil
7	Theory Exam-III	**40**
8	Report-I	Nil

9	Report-II	Nil
10	Report-III	Nil
11	Project-I	**40**
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	Nil
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total	**100**

Course Title and Code: Transport Phenomena ME1104	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	**B. Tech Semester-IV (Core)**

Course Objective:

The objective of this course is to introduce the concepts of transport phenomena, which deals with the movement of different physical quantities such as momentum, energy and mass in any chemical or mechanical process and combines the basic principles (conservation laws) and laws of various types of transport. The topics included in this course are aimed to prepare a student to build a good fundamental background useful in the application-intensive courses covering hydraulics and energy transfer equipment design in later semesters.

On successful completion of this course, the student should be able to:

1. identify the basic transport processes in our day to day life and industrial processes
2. apply the continuity, momentum and energy principles and dimensional analysis
3. formulate and analyse a heat transfer problem involving any of the three modes of heat transfer
4. apply the appropriate correlations to calculate heat transfer coefficient and heat flux for a range of heat transfer situations (Steady and unsteady)
5. design and model a real life low energy heat transfer equipment as per ASME standard
6. Analyse the combined effect of heat, mass and momentum transport in a typical chemical engineering equipment (heat exchanger, catalyst bed, chemical reactor, etc.)

Sr. No	**Specifications**	**Marks**
1	Attendance	--
2	Assignment	5+5
3	Class Participation	--
4	Quiz	5+5
5	Theory Exam-I	15
6	Theory Exam-II	15
7	Theory Exam-III	25
8	Report-I	--
9	Report-II	--
10	Report-III	--
11	Project-I	--
12	Project-II	--
13	Project-III	--
14	Lab Evaluation-I	10
15	Lab Evaluation-II	15
16	Course Portfolio	--
	Total (100)	**100**

Evaluation for retest		
1	Theory Exam-III	25
2	Lab Evaluation-II	15
	Total	**40**

Syllabus:

Momentum Transport:

Basic Concepts and Definitions – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity, Newton law of viscosity, vapour pressure, boiling point, cavitation, surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Fluid Statics - Fluid Pressure, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U Tube Differential Manometer, Micromanometers, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

Fluid Kinematics-Classification of fluid flow: steady and unsteady flow, uniform and non-uniform flow, laminar and turbulent flow, rotational and irrotational flow, compressible and incompressible flow, ideal and real fluid flow, one, two and three dimensional flows, Stream line, path line, streak line and stream tube, stream function, velocity potential function. One-, two- and three - dimensional continuity equations in Cartesian coordinates

Fluid Dynamics- Surface and body forces, Equations of motion - Euler's equation, Bernoulli's equation – derivation, Energy Principle, Practical applications of Bernoulli's equation, venturimeter, orifice meter and pitot tube, Momentum principle, Forces exerted by fluid flow on pipe bend, Vortex Flow – Free and Forced, Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number, Buckingham's π-Theorem.

Energy Transport

Energy equation, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins.

Convection: basic equations, boundary layers- Forced convection, external and internal flows, Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

Radiation**:** Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method

Mass Transport:

Introduction mass transfer, Diffusion mass transfer, Fick's law of diffusion, Steady state molecular diffusion, Convective mass transfer and mass transfer coefficient, Interphase mass transfer, Momentum, heat and mass transfer analogy.
Distillation: Vapour liquid equilibrium, Flash vaporization, steam distillation, batch distillation, and continuous multistage fraction of binary mixtures.
Drying of wet solids: Physical mechanism of drying, drying equilibria, drying rate curve, calculation of the drying time from the drying rate data, classification of drying equipment.
Adsorption: Commercial adsorbents and their applications, characteristics and properties of adsorbent, Adsorption equilibria, selection of adsorbents, adsorbent equipments.

Text Books:

1. Cengel Y. and Cimbala J., "Fluid Mechanics" Tata McGraw-Hill, New Delhi, 2014.
2. White F. M., "Fluid Mechanics" Tata McGraw-Hill, New Delhi, 2011.
3. Bird, Stewart and Lightfoot, "Transport Phenomena"', John Wiley & Sons, 2002.
4. Incropera F P "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 2011.
5. Cengel Y. "Heat and Mass Transfer" Tata McGraw-Hill, New Delh, 2014i.

Reference Books:

2. Fox and McDonald, "Introduction to fluid dynamics", John Wiley & Sons, 2018.
3. Holman J.P. "Heat Transfer" Tata McGraw-Hill, New Delhi, 2008.
4. Robert T., "Mass Transfer Operations" Tata McGraw-Hill, New Delhi, 1995.
5. Binay K. Dutta, Principles of Mass Transfer and Separation Processes, PHI Learning Pvt.Ltd. Delhi, 2007.

Lab Experiments

Measurement of viscosity, Study of Pressure Measuring Devices, Stability of Floating Body, Hydrostatics Force on Flat Surfaces/Curved Surfaces, Verification of Bernoulli's Theorem, Venturimeter, Orifice meter, Impacts of jets, Flow Visualisation -Ideal Flow Length of establishment of flow, Velocity distribution in pipes, Laminar Flow, Convective heat transfer (Numerical). Solid/ liquid in air diffusion.

Course Title and Course Code	**Strength of Material & Analysis (ME1105)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-IV ME**

Course Objective:

The key objective of this course is to acquaint the students with fundamentals of stress and strain for 1-D, and 2-D systems, factors cause failure and theories to avoid failure.

Learning Outcomes:

On successful completion of this course, the students will be able to:

1. identify stress and strain present in a mechanical system.
2. analyze and evaluate 1-D and 2-D stress tensor in a specimen.
3. analyze shear force and bending moment diagrams for a beam under different loading conditions.
4. design shafts against torsion load for different application.
5. design columns against buckling load for various end conditions.

Sr. No	Specifications	Marks	S#1	S#2
1	Attendance	NIL	NIL	NIL
2	Assignment	10	10	10
3	Class Participation	NIL	NIL	NIL
4	Quiz	10	10	10
5	Theory Exam-I	10	10	10
6	Theory Exam-II	NIL	NIL	NIL
7	Theory Exam-III	30	30	30
8	Report-I	NIL	NIL	NIL
9	Report-II	NIL	NIL	NIL
10	Report-III	NIL	NIL	NIL
11	Project-I	20	20	20
12	Project-II	NIL	NIL	NIL
13	Project-III	NIL	NIL	NIL
14	Lab Evaluation-I (Continuous)	10	10	10
15	Lab Evaluation-II (Exam)	10	10	10

16	Course Portfolio	NIL	NIL	NIL
Total (100)		**100**	**100**	**100**
Evaluation scheme for Retest		**Marks**		
1	Theory Exam-Retest	30	30	30
Total (30)		**30**	**30**	**30**

COURSE SYLLABUS (Theory):

UNIT 1 Stresses and Strains

Simple Stresses and Strain: Introduction, Definition and concept and of stress and strain. Hooke's law, Stress-Strain diagrams for ferrous and non-ferrous materials, factor of safety, Elongation of tapering bars of circular and rectangular cross sections, Elongation due to self-weight. Saint-Venant's principle, Compound bars, Temperature stresses, Compound section subjected to temperature stresses, state of simple shear, Elastic constants and their relationship.

Unit II Multiaxial Stress-Strain System

Introduction to Biaxial stresses, state of stress at a point, General two-dimensional stress system, Principal stresses and principal planes, Mohr's circle of stresses and Introduction to Theories of Failure.

Thin and Thick Cylinders (Cartesian Coordinates): Introduction, Thin cylinders subjected to internal pressure; Hoop stresses, Longitudinal stress and change in volume. Thick cylinders subjected to both internal and external pressure; Lame's equation, radial and hoop stress distribution.

UNIT III Theory of Beams

Introduction to types of beams, supports and loadings. Definition of bending moment and shear force, Sign conventions, relationship between load intensity, bending moment and shear force. Shear force and bending moment diagrams for statically determinate beams subjected to points load, uniformly distributed loads, uniformly varying loads, couple and their combinations, Deflection of beams by Double integration method–Macaulay's method–Area moment theorems for computation of slopes and deflections in beams –Conjugate beam method.

UNIT IV Bending and Torsion

Theory of simple bending –bending stress and shear stress in beams, assumptions, bending equation, modulus of rupture, section modulus, flexural rigidity, Bending and shear stress distribution diagrams for circular, rectangular, 'I', and 'T' sections.

Introduction, pure torsion, Assumptions, Torsion equation for circular shafts, torsional rigidity and polar modulus Power transmitted by a shaft, combined bending and torsion.

UNIT V Column and Struts and Introduction to 3-D stresses

Introduction, short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory. Rankine-Gordon's formula for columns. Fundamentals of theory of elasticity.

COURSE SYLLABUS (Practical):

1. To evaluate stress strain curve for tension test on a standard Mild Steel specimen on Universal Testing Machine UTE-20.
2. To evaluate stress strain curve for compression test on a standard Mild Steel specimen on Universal Testing Machine UTE-20.
3. To conduct impact test on a mild steel specimen, IT-30.
4. To conduct torsion test on a mild steel specimen, TTE-10.
5. To conduct Rockwell Hardness Test.
6. To conduct Brinell's Hardness Test.
7. To conduct Vickers Hardness Test, VM-50.
8. To conduct fatigue test on Fatigue Testing machine, FTG 8(D).
9. To conduct bending stress in a beam, STR 5.
10. To write a MATLAB program to generate principle stress, shear stress of a given element and plot the same.
11. To write a MATLAB program to generate 2-D principle stress, shear stress of a given element and plot the same.
12. To write a MATLAB program to generate Mohr's Circle of a given element and plot the same.
13. To develop a CAD Simulation model of Mild steel specimen for conducting simulation.
14. To develop a CAD Simulation model of Aluminum specimen for conducting simulation.

Text Books:

1. S. S. Rattan "Strength of Materials" McGraw Hill Education (India) Pvt. Ltd., 2nd Edition (Sixth reprint 2013)
2. Popov, Egor Paul. Engineering mechanics of solids. Prentice Hall, 1990.
3. R. K. Bansal, "A Textbook of Strength of Materials", 4th Edition, Laxmi Publications, 2010.

Reference Books:

1. Timoshenko, S. and Goodier, J. N., "Theory of Elasticity", Tata McGraw Hill, New Delhi, 3rd edition, 1970
2. Srinath, L. S., "Advanced Mechanics of Solids", Tata McGraw Hill, New Delhi, 3rd edition, 2010
3. Ferdinand P. Beer, E. Russell Johnston and Jr. John T. DeWolf "Mechanics of Materials", Tata McGraw-Hill, Third Edition, SI Units.

4. D.H. Young, S.P. Timoshenko “Elements of Strength of Materials” East West Press Pvt. Ltd., 5th Edition (Reprint 2014)
5. Vazirani, V. N., Ratwani M. M. and S K Duggal "Analysis of Structures Vol. I", 17th Edition, Khanna Publishers, New Delhi.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
ES1109	Computational Engineering Analysis – II	3	1	2	0	5

Course Objectives: The course will develop ability to use Partial Differential Equations (PDE), Fourier transforms and Z-transform for a variety of Engineering applications from fluid dynamics, heat conduction and circuit design**.** It also aims to develop skills for using common simulation software i.e. ANSYS Fluent and MATLAB. Few numerical methods will also be introduced to find the numerical solutions of various problems.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Classify various types of partial differential equations and solve them through various analytical and numerical methods.
2. Formulate and analyze differential equations especially Navier stokes and energy equations and use numerical methods for solving the same.
3. Use CFD software to model relevant engineering flow problems.
4. Find Fourier and inverse Fourier transforms of given function and use Fourier transform to solve partial differential equations.
5. Find Z-transform and inverse Z-transforms of given functions and use them to analyse control systems.
6. Design and analyse various types of filters and attenuators to minimize power losses and improve signal quality.
7. Solve problems involving vertex and edge connectivity, planarity and crossing numbers.

Assessment Scheme:

Prerequisites		**Elementary Calculus**
Teaching Scheme (Hours per Week)		**L T P 3 1 2**
Credits		**5**
S No	**Evaluation Component**	**Marks**
1	Attendance	NA
2	Assignment	10
3	Class Participation	NA
4	Quiz	5
5	Theory Exam-I	15
6	Theory Exam-II	15
7	Theory Exam-III	30
8	Report-I	NA
9	Report-II	NA

10	Report-III	NA
11	Project-I	NA
12	Project-II	NA
13	Project-III	NA
14	Lab Evaluation-I	10
15	Lab Evaluation-II (Continuous)	15
16	Course Portfolio	NA
	Total (100)	100
Evaluation Scheme for Re-Test		
1	Theory Exam-III	30
	Total	30

Course Syllabi (Theory):

PDE: Partial Differential Equations of First Order, Variable separable technique for solving PDE. Heat equation, wave equation, Laplace equation

Boundary value problems: Solution of boundary value problems using separation of variables technique.

Numerical solution of PDE.

Application of PDE: Momentum and Energy Transport:

The governing equations of fluid dynamics- models of the flow, continuity equation, momentum equation, Energy equation, boundary conditions. Poisouli's flow, Couette flow, steady and unsteady conduction.

Fourier Transforms: Fourier transform and inverse Fourier transform, properties of Fourier transform, Applications in solving Partial differential equations.

Filter Circuits: Types of passive filters, design low-pass, High-pass, Band-pass, Band-reject filters as constant k type, design low-pass, High-pass, Band-pass, Band-reject filters as m-derived type, Advantages of active filters over passive filters.

Graph Theory: Introduction, Linear graph of a network, Tie-set and cut-set schedule, incidence matrix, cut-set, and tie-set. Graph theory application to a practical radial system.

Z-transform: Introduction, standard z- transform, properties of z – transform, initial and final value theorems, inverse z-transform, applications in control systems.

Textbook:

1. Advanced Engineering Mathematics, Erwin Kreysig, Wiley, India.
2. White F. M., "Fluid Mechanics" Tata McGraw-Hill, New Delhi.
3. Incropera F P "Principles of Heat and Mass Transfer", John Wiley & Sons.
4. Hayt W.H., Kemmerly J. E., Durbin S. M., "Engineering Circuit Analysis", Tata Mcgraw Hill, 6th edition, 2006.

Reference Books –

1. Thomas' Calculus, M.D. Weir and J. Hass, Pearson.

2. Engineering Mathematics, Srimanta Pal and Subodh C. Bhunia, Oxford University Press, New Delhi, India.
3. Higher Engineering Mathematics, B.V. Ramana, Mc Graw Hill Education.
4. Fox and McDonald, “Introduction to fluid dynamics”, John Wiley & Sons.
5. Cengel Y. “Heat and Mass Transfer” Tata McGraw-Hill, New Delhi.
6. J. D. Anderson Jr. “Computational Fluid Dynamics” McGraw-Hill International Edition.
7. Roy Choudhary, “Network Theory”, TMH, 3rd Edition, 2004.
8. Edminister Joseph A., “Electrical Circuits, Schaum’s Outline Series”, Tata McGraw Hill, 3rd edition, 2012.

Course Title	**Production Technology – I**
Course Code	**ME1106**
Hours per Week (L T P)	**3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-IV (Batch: 2018-2022)/Core**

Course Objective:

To impart knowledge about principles/methods of casting with knowledge of pattern, molding, casting methods in order to get sound casting. To impart knowledge about welding processes in order to get sound permanent joints of metal and metal alloys. To impart knowledge of working principles of various non-conventional and advanced machining processes.

Learning Outcome:

On successful completion of this course, the students will be able to:

1. Design molding system to obtain defect free cast.
2. Analyze various welding processes for different applications.
3. Identify non-conventional manufacturing process to manufacture intricate shaped product accurately.
4. Identify latest manufacturing systems and processes for manufacturing of components.

Prerequisites: Basics of Materials Engineering

Sr. No	**Specifications**	**Marks**
1	Attendance	5
2	Assignment	10
3	Class Participation	NIL
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	20
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**

Evaluation scheme for Re-test

Sr. No	Specifications	Marks
1	Theory Exam-III (Re-test)	30
Total (30)		**30**

Course Syllabus (Theory)

Conventional Manufacturing processes:

UNIT-I

Casting and molding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, gating system design, riser design, casting defects and residual stresses.
Melting Practices: Cupola, Induction Furnaces

UNIT-II

Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes, welding defects; Adhesive bonding.

Unconventional Machining Processes:

UNIT-III

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters.
Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining

UNIT-IV

Introduction to Flexible Manufacturing System, Additive manufacturing: Rapid prototyping and rapid tooling.

Text Book(s)

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
3. Degarmo, Black & Kohser, Materials and Processes in Manufacturing

4. Amitabh Ghosh & Mallik, Manufacturing Science, Affiliated East-West Press Pvt Ltd, New Delhi.

Reference Book(s)

1. Rao P. N. "Manufacturing Technology: Foundry, Forming and Welding" TMH, 2013.
2. James S. Campbell "Principles of Manufacturing Materials and Processes", TMH.
3. G.E. Linnert, "Welding Metallurgy" AWS.
4. Cook "Manufacturing Analysis"Adisson-Wesley
5. R. K. Jain "Manufacturing Engineering Technology" Pearson Education
6. P. C. Pandey and C. K. Singh "Production Engineering Sciences" Standard Publishers Ltd.

Course Syllabus (Practical):

1. To determine moisture content in molding sand,
2. To determine the clay content of molding sand,
3. To perform the Hardness Test to know hardness of molding/core sand.
4. To prepare wood/metal pattern for casting process.
5. To cast a liquid Aluminum metal by using sand molding.
6. Investigate the casting defects and suggest the remedial measures.
7. To make a component involving horizontal and vertical welding using gas welding.
8. To make a component using TIG welding setup.
9. To make a component using MIG welding setup.
10. To prepare a permanent joint on mild steel plate using gas welding.
11. To prepare a permanent joint on thin metallic sheet using spot welding.
12. To find out average grain fineness number using sieve shaker.

Communication and Identity
Course Code: CC1104
Credit: 2
L-T-P: 2-0-1

Course Description:
This course enables students to explore their personal and professional identities, to create their distinctive presence. It intends to help them gain an understanding of the basic purpose, benefits, and responsibilities of self-presence, and to begin the process of defining their values, strengths, and goals, which also helps them enhancing their professional readiness.

Learning Outcomes:
- Analyse their personal identities, both private and social
- Identify their different values, strengths and areas of professional interest
- Articulate their personal statement and use it to craft an influential pitch
- Express themselves through various communication formats on different platforms

Course Contents
1. **Self- identity**
2. **Personal Statement**
3. **Internal confidence or "principle centered living"**
4. **External and internal locus of Identity**
5. **Steps to build Personal Identity**
6. **Online presence**
7. **Elevator Pitch, Cover Letter**

Evaluation Scheme:

Sr. No	**Specifications**	**Weightage**	
		Original	**Revised (post covid 19)**
1	Attendance	Nil	Nil
2	Assignment	30	30
3	Class Participation	30	30
4	Quiz	Nil	Nil
5	Theory Exam II	Nil	Nil
6	Theory Exam III	20	25 (Continuous Evaluation)
7	Theory Exam	20	15 (Evaluation Based on Mooc Course Completed)
	Total (100)	**100**	**100**

References for Reading:

1. O’Brien, T. (2019). When your job is your identity, professional failure hurts more. Harvard Business Review.
2. Anca, C., & Aragón, S. (2018). The 3 types of diversity that shape our identities. Harvard Business Review.
3. Craig, N., & Snook, S. (2014). From purpose to impact. Harvard business review, 92(5), 104-111.
4. Detert, J. R. (2018). Cultivating everyday courage. Harvard Business Review, 96(6), 128-135.
5. Dutta, S. (2010). What's your personal social media strategy? Harvard business review, 88(11), 127-30.

Course Title: Introduction to Design
Course Code: **IL1102**

Hours per Week	30
Credits	2
Students who can take	2nd Year B. Tech

Course Objective: Taking an idea forward from an intangible thought to a material-based product or visually communicable form requires a definitive plan of action. Using the methods of design thinking and design process the students will be able to bring their ideas to life.

Learning Outcome:
On successful completion of this course, the students should be able to:

1. Sketch their ideas on paper to visualize and assess viability.
2. Create a plan for process and management to materialize the desired idea.
3. Test the material for possibilities and capabilities.
4. Develop skills of joinery, material manipulation and various hand tools.
5. Develop technical and narrative skills useful for both film and animation.
6. Develop Troubleshooting and problem solving skills.

Evaluation Scheme

Sr. No	Specifications	Marks
1	Attendance	Nil
2	Assignment	20
3	Class Participation	10
4	Quiz	Nil
5	Theory Exam I	Nil
6	Theory Exam II	Nil
7	Theory Exam III	Nil
8	Report-1	Nil
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	35
12	Project -2	35
13	Project -3	Nil
14	Lab Evaluation1	Nil
15	Lab Evaluation2	Nil

16	Course portfolio	Nil
	Total (100)	**100**

Course Contents:

Introduction to Design Process.
Material properties – wire and wood.
Material joinery – Mortise and Tenon, Dowel Joints.
Use of tools – plier, grinder, saw.
Developing creative thinking.
Basic drawing and visualisation skills including 2D to 3D - Form exploration.
Principles of animation.
Technical aspects of animation and film making (Frame rate, persistence of vision).
Building a Narrative – Start, Middle and End of a story.
Mediums of animation.

Course Title and Course Code	**Mechanical Engineering CAD Lab (ME1107)**
Hours per Week	**L T P: 0 0 2**
Credits	**1**
Students who can take	**B. Tech Semester-IV ME**

Course Objective:

To develop competencies in machine drawing to create blue prints.

Learning Outcomes:

On successful completion of this course, the students will be able to:

1. identify surface roughness number and symbol, symbols of machine elements and welded joints limit.
2. assess limits, fits and tolerance for machine elements in engineering drawings.
3. develop geometrical models for different machine components.
4. develop assembly and detailed drawings of engine parts.

Prerequisites		**Basics of Physics**		
Sr. No	**Specifications**	**Marks**	**S#1**	**S#2**
1	Attendance	5	5	5
2	Assignment	25	25	25
3	Class Participation	NIL	NIL	NIL
4	Quiz	NIL	NIL	NIL
5	Theory Exam-I	NIL	NIL	NIL
6	Theory Exam-II	NIL	NIL	NIL
7	Theory Exam-III	NIL	NIL	NIL
8	Report-I	NIL	NIL	NIL
9	Report-II	NIL	NIL	NIL
10	Report-III	NIL	NIL	NIL
11	Project-I	40	40	40
12	Project-II	NIL	NIL	NIL
13	Project-III	NIL	NIL	NIL
14	Lab Evaluation-I	15	15	15
15	Lab Evaluation-II	15	15	15
16	Course Portfolio	NIL	NIL	NIL
Total (100)		**100**	**100**	**100**
Evaluation Scheme for Retest		**Marks**		
1	Lab Evaluation-Retest	30	30	30

Total	**30**	**30**	**30**

COURSE SYLLABUS (Theory):

UNIT - I

Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints.

Limits, Fits and Tolerances: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, commonly used holes and shafts.

Fasteners: Drawings of various views of Screw threads, metric and BSW threads, Square thread and multi start threads. Nuts & bolts, Washers, Setscrew, Locknuts and foundation bolts.

UNIT - II

Drawings of various views of:

Shaft joints: Cotter joint and Knuckle joint.

Keys & Shaft coupling: Muff, Flanged, Flexible, Universal and Oldham's coupling.

Shaft bearing: Solid and bush bearing, Plummer block.

Pipe Joint: Flanged joint, Socket and Spigot joint, Hydraulic joint, Union joint, Expansion joint.

Pulley: V-belt pulley.

Gears: Spur gear in mesh with approximate construction of tooth profile, Rack and pinion.

UNIT – III

Assembly and detailed drawings of Engine Parts: Piston, stuffing box, cross head, Vertical & Horizontal engine, Connecting rod, Crank.

Valves: Steam stop valves.

Text & Reference Books:

1. Engineering Drawing: N.D.Bhatt & M.Panchal 37th Edition 1996, charotar publishing House Gujarat
2. Machine Drawing – P. S. Gill S.K. Kataria & Sons Delhi.
3. Engineering Drawing & Design: Cencil Jensen, Jay D. Helsel, Dennis R. Short, Seventh Edition, Tata Mcgraw Hill 2012
4. "Engineering Graphics" by K.L. Narayana and P.Kannaiah, scitech publications (india) pvt.ltd. october 2008
5. Engineering Drawing: K.R. Gopal Krishna, 24 th Edition 1999 Subhash publications, Bangalore

Course Title and Course Code	**Computer Aided Modeling and Simulation (ME1206)**
Hours per Week	**L T P: 1 0 2**
Credits	**2**
Students who can take	**B. Tech Semester-IV & VI ME**

Course Objective:

To develop competencies in CAD modeling and simulation for effective concurrent engineering.

Learning Outcomes:

On successful completion of this course, the students will be able to:

1. design mechanical parts using CAD software.
2. assess the use of tool to create, constrain, and edit sketched features.
3. assess the use of modeling & assembly tools to create and constrain components.
4. generate simulation results for any machine part and assembly.

Prerequisites		**Basics of Physics**		
Sr. No	**Specifications**	**Marks**	**S#1**	**S#2**
1	Attendance	5	5	5
2	Assignment	25	25	25
3	Class Participation	NIL	NIL	NIL
4	Quiz	NIL	NIL	NIL
5	Theory Exam-I	NIL	NIL	NIL
6	Theory Exam-II	NIL	NIL	NIL
7	Theory Exam-III	NIL	NIL	NIL
8	Report-I	NIL	NIL	NIL
9	Report-II	NIL	NIL	NIL
10	Report-III	NIL	NIL	NIL
11	Project-I	40	40	40
12	Project-II	NIL	NIL	NIL
13	Project-III	NIL	NIL	NIL
14	Lab Evaluation-I	15	15	15
15	Lab Evaluation-II	15	15	15
16	Course Portfolio	NIL	NIL	NIL
	Total (100)	**100**	**100**	**100**
Evaluation Scheme for Retest		**Marks**		
1	Lab Evaluation-Retest	30	30	30
Total (30)		**30**	**30**	**30**

COURSE SYLLABUS:

UNIT – I

Introduction to 2-D & 3-D Modeling:

Creating a New Part File, Sketched Base Features, Primitive Base Features, Sketch Geometry, Advanced Editing Tools, Rectangle & Circular Sketch Patterns, Over-Dimensioned Sketches, Sketch Preferences, Extruded Secondary Features, Revolved Secondary Features, Using Existing Geometry, Editing Sketched Secondary Features, Edge Chamfer, Constant Fillets, Variable Fillets, Face Fillets, Full Round Fillets, Straight Holes, Threads, Creation Sequence, Section Views.

UNIT - II

Advance 3-D modeling and Assembly:

Creating a New Part, Rail Lofts, Center Line Lofts, Advanced Loft Options, Rectangular Feature Patterns, Circular Feature Patterns, Mirror Parts or Features, Manipulate Patterns and Mirror Features, Assembling Components using Constraints, Content Center, Assembly Browser, Assembling Components using Joints, Moving and Rotating Assembly Components, Selection Options in Assemblies, Measurement Tools, Model Properties, Assembly Parts, Assembly Features.

UNIT - III

Surfacing, and Drafting:

New Drawing Views, Manipulating Views, Dimensions, Drawing Sheets, Parts List, Balloons, Styles and Standards, Hatching, Text, Symbols, Hole and Thread Notes, Chamfer Notes, Center Marks and Center Lines, Hole Tables, Revision Tables and Tags.

UNIT - IV

Static & Dynamic Simulation

General Working of FEA, Nodes, Elements, General Procedure of Conducting Finite Element Analysis

through inventor, Structural Analysis, Material Properties, Mesh Generation, Mesh Density, Defining the New Analysis Type, Restarting the Analysis, Setting Analysis Options, Solving the Analysis Problem, Dynamic Analysis.

Text Books:

1. Tickoo, Sham. Autodesk Inventor 11 For Engineers & Designers (With Cd). Dreamtech Press, 2006.
2. Shih, Randy. Parametric Modeling with Autodesk Inventor 2014. SDC Publications, 2013.
3. Bethune, James D. Engineering Design Graphics with Autodesk Inventor 2020. Macromedia Press, 2019.
4. Zeid, Ibrahim. CAD/CAM theory and practice. McGraw-Hill Higher Education, 1991.

Course Title and Course Code	**Theory of Machines (ME1108)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
O Students who can take	**B. Tech Semester-V (Batch: 2018-2022)**

Course Objective:

This course aims to impart knowledge on design and analysis of mechanism for the specified type of motion in a machine and transmission systems.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Compare and develop various application based linkages and mechanisms
2. Analyze velocity and acceleration polygon of different types of mechanisms.
3. Analyze the cam and follower mechanism in order to optimize the power consumption.
4. Prioritize among various mechanisms like belt, rope and chain drive systems in order to minimize energy consumption.

Prerequisites		**Basics of Physics**
Sr. No	**Specifications**	**Marks**
1	Attendance	NIL
2	Assignment	10
3	Class Participation	NIL
4	Quiz	20
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	10
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**

Evaluation scheme for Re-test

Sr. No	Specifications	Marks
1	Theory Exam-III (Re-test)	30
Total (30)		**30**

COURSE SYLLABUS (Theory):

UNIT - I

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms

(8 lectures)

UNIT - II

Kinematic Analysis of Mechanisms:

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics Coincident points- Coriolis component of acceleration- introduction to linkage synthesis three position graphical synthesis for motion and path generation. **(12 lectures)**

UNIT - III

Cams: Classification of cams and followers- Terminology and definitions- Displacement diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers. **(12 lectures)**

UNIT – IV

Belts, Ropes and Chains: Mechanism of belt, rope and chain drive, power transmitting capacity, effect of centrifugal forces, material used for Belts, rope and chain.

(4 lectures)

Vibration: Introduction to vibration, single degree of freedom (free Vibration)

(4 lectures)

COURSE SYLLABUS (Practical):

1. (i) To study the various types of link, and pair mechanism.
   (ii) To study the inversions of four bar mechanism.

2. To determine whirling speed of shaft theoretically and experimentally.
3. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
4. To determine the natural frequency of un-damped torsional vibration of a single rotor shaft system.
5. To determine the natural frequency of un-damped torsional vibration of two rotor shaft system.
6. To Analyze the motion of a motorized gyroscope when the couple is applied along its spin axis.
7. To determine the frequency of un-damped free vibration of an equivalent spring mass system.
8. To determine the frequency of damped force vibration of a spring mass system/related case study.
9. To study the static and dynamic balancing using rigid blocks/related case study.
10. To plot follower displacement Vs cam rotation graph for various cam follower arrangement.

Text Books:

1. Rattan S.S, "Theory of Machines" Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 2nd edition -2005.
2. Sadhu Singh, "Theory of Machines," Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi, 2ND Edi. 2006.
3. Jagadish Lal, 'Theory of Machine', Dhanpat Rai Publications, New Delhi.

Reference Books:

1. Shigley. J. V. and Uickers, J.J., "Theory of Machines & Mechanisms" OXFORD University press.2004
2. "Theory of Machines -I", by A.S.Ravindra, Sudha Publications, Revised 5th Edi. 2004.
3. "Theory of Machines ", by Thomas Bevan, CBS Publishers and Distributors.

Course Title and Course Code	**PRODUCTION TECHNOLOGY - II (ME1109)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-V (Batch: 2018-2022)**

Course Objective:

The main objective of the course is to impart knowledge of production technology so that students are able to design and perform various forming and machining processes to shape materials for different applications.

Learning Outcomes:

On successful completion of this course, the students will be able to:

1. Design load capacity of forming equipment to perform various bulk forming and sheet forming operations.
2. Design of machining tools, forming tools and holding tools for various forming and machining processes.
3. Calculate force required for machining metallic materials using appropriate cutting tool materials and cutting fluids.
4. Use cutting, milling, and finishing operations to shape materials and evaluate their surface finish using conventional and automatic machines.

Prerequisites: Basics of Materials Engg, PT-I

Evaluation Scheme

Sr. No	Specifications	Marks
1	Attendance	NIL
2	Assignment	20
3	Class Participation	NIL
4	Quiz	20
5	Theory Exam-I	10
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	10
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL

13	Project-III	NIL
14	Lab Evaluation-I	NIL
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**

Evaluation Scheme for Re-test		
Sr. No	**Specifications**	**Marks**
1	Theory Exam-III	30
Total (30)		**30**

Course Contents:

UNIT - I

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending), principles of powder metallurgy. **(8)**

UNIT - II

Tooling for conventional and non-conventional machining processes: Mold and die design, Press tools, Cutting tools; **(6)**

Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design. **(6)**

UNIT - III

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, cutting tool materials, Cutting fluids. **(10)**

UNIT - IV

Turning, Drilling, Milling and finishing processes, Surface finish and integrity, Coating. **(8)**

Introduction to CNC machining. **(2)**

Course Syllabus (Practical)

1. Study of single point cutting tool geometry & grind the tool as per given tool geometry / related case study.
2. To prepare a job using lathe machine / related case study.
3. To prepare a gear using Milling Machine / related case study.

4. Study the milling machine, milling cutters, indexing heads and indexing methods / related case study.
5. Prepare a hexagonal / octagonal nut using indexing head on milling machine / related case study.
6. To cut external metric threads & to meet it with the nut / related case study.
7. To prepare the job by eccentric turning on lathe machine / related case study.
8. To prepare a job on shaper from given MS rod / related case study.
9. To prepare a job on surface grinder and measure the various parameters of the finished piece / related case study.
10. Disassembly and assembly of small assemblies such as three jaw chuck, four jaw chuck, tail stock, bench vice, screw jack etc. / related case study.

Text Books and Reference Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
3. Degarmo, Black & Kohser, Materials and Processes in Manufacturing
4. Amitabh Ghosh & Mallik, Manufacturing Science, Affiliated East-West Press Pvt Ltd, New Delhi.

Online References:

1. Fundamentals of manufacturing process by NPTEL
   https://swayam.gov.in/nd1_noc20_me67/preview
2. Principles of metal forming technology by NPTEL
   https://swayam.gov.in/nd1_noc20_me72/preview

3. Advanced Manufacturing Process Analysis by Coursera
   https://www.coursera.org/programs/j-k-lakshmipat-university-on-coursera-kzogk/browse?currentTab=CATALOG&index=prod_enterprise_products&productId=9_tBpYquEeatfg7c63n1lQ&productType=course&query=production+technology&showMiniModal=true

Course outline

Course Title and Code – Understanding and Managing Conflict| CC1105|Semester- V

Course Description

In today's increasingly complex and fragmented world, it is important to be able to resolve conflicts and build healthy relationships. Interpersonal and Group Dynamics is a course designed to prepare students to identify conflicts, manage emotions, analyze the situation and characters, and practice different frameworks to deal with conflicts.

Learning Outcomes

The students will be able to:

- Define a group and explain the stages of group development
- Describe conflict and explain types and causes of conflict
- Use inquiry and advocacy to engage with groups
- Give and receive feedback effectively
- Identify sources of conflict and manage them using difference conflict handling styles

Prerequisites		**N/A**
Hours per Week		**L-T-P: 2-0-0**
Credits		**2**
Sr. No	**Specifications**	**Marks**
1.	Attendance	Nil
2.	Assignment	30
3.	Class Participation	20
4.	Quiz	20
5.	Theory Exam-I	Nil
6.	Theory Exam-II	Nil
7.	Theory Exam-III	30
8.	Report-I	Nil
9.	Report-II	Nil
10.	Report-III	Nil
11.	Project-I	Nil
12.	Project-II	Nil
13.	Project-III	Nil
14.	Lab Evaluation-I	Nil

15.	Lab Evaluation-II	Nil
16.	Course Portfolio	Nil
	Total (100)	100

Course Content

1. Introduction to the stages of group development
2. Introduction to Personality, Perception and Learning as source of differences in individual and groups
3. Nature, Types and sources of Conflict
4. Conflict Resolution Strategies
5. Emotional Intelligence
6. Empathy and Feedback
7. Inquiry & Advocacy – Concept of silence (Masking, Avoiding, Withdrawing) and violence (Controlling, Labeling, Attacking)

References for Reading:

1. Fisher, R., & Ury, W. (2011). Getting to yes: Negotiating agreement without giving in. Toronto, ON: Penguin Random House.
2. Harper, G. (2004). The joy of conflict resolution: Transforming victims, villains and heroes in the workplace and at home. Gabriola Island, BC: New Society Publishers.
3. Miles, E. W. (2013). Developing strategies for asking questions in negotiation. Negotiation Journal, 29(4): 383–412. doi: 10.1111/nejo.12034.

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
EE1111	Introduction to Internet of Things (IoT)	1	0	2	0	2

Course Objectives:

The course aims to develop understanding of Internet of Things concepts and working on IoT development boards to interface sensors and actuators. The course will enable the students to upload data from sensors on a web server and to use this data for analytical purposes or to actuate some transducers.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Interface the Analog and Digital sensors to Node-MCU
2. Develop Embedded C programs to read sensor data and upload to public cloud platform.
3. Use Python-based IDE (integrated development environments) for the Raspberry Pi
4. Interface Raspberry Pi with I/O devices.
5. Visualize sensor data uploaded on public cloud.
6. Apply standard protocol(s) for implementation of IoT Systems.
7. Analyze and Improve existing systems with innovative IoT based approaches.

Assessment Scheme:

Prerequisites		**Basic Programming**	
Teaching Scheme (Hours per Week)		L T P 1 0 2	
Credits		2	
Sr. No.	**Evaluation Component**	**Marks**	
1	Attendance	NA	
2	Assignment	NA	
3	Class Participation	NA	
4	Quiz	10	
5	Theory Exam-I	10	
6	Theory Exam-II	NA	
7	Theory Exam-III	20	
8	Report-I (Case Study on Raspberry Pi, IoT)	20	
9	Report-II	NA	
10	Report-III	NA	
11	Project-I	NA	
12	Project-II	NA	
13	Project-III	NA	
14	Lab Evaluation-I (Continuous)	30	

	15	Lab Evaluation-II	NA	
	16	Course Portfolio (MOOC certificate)	10	
		Total (100)	100	

	Evaluation Scheme for Retest		
1		Theory Exam-III	20
2		Lab Evaluation-II	0
		Total (40)	20

Course Syllabi (Theory):

UNIT 1: Introduction to IoT Fundamentals: Definition, Characteristics, Applications, Connectivity Layers, Addressing, Networking.

UNIT 2**:** Sensors and Actuators: Sensors and Transducers, Sensor Classes, Sensor Types, Actuator Basics, Actuator Types,

UNIT 3**:** Basics of IoT Networking & Protocol: IoT Components, Inter-dependencies, SoA, Wireless Networks, Protocol Classification, MQTT, Secure MQTT, CoAP, XMPP, AMQP (Advanced Message Queuing Protocol)

UNIT 4**:** Connectivity Technologies: IEEE 802.15.4, ZigBee, 6LoWPAN, RFID, HART, NFC, Bluetooth, Zwave.

UNIT 5**:** Introduction to NodeMCU and Server: Basic Concepts of Arduino Platform, Examples of Arduino Programming, Interfacing different sensors with NodeMCU. Introductio to Blynk App, Uploading and downloading data from server using Blynk App. Intoduction to ThingSpeak Server, Uploading and downloading data from ThingSpeak server.

UNIT-6 Raspberry Pi: Basic functionality of the Raspberry Pi B+ board, Setup and Configuring Raspberry Pi, programming on the Raspberry Pi using Python, Python functions to access the Raspberry Pins, how Raspberry Pi interact with online services through the use of public APIs and SDKs, case studies.

References:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)

3. Rajkamal, Internet of Things, Architecture and Design Principles, Mc. Graw Hill Education (India) Pvt Ltd.
4. IoT fundamentals: networking technologies, protocols, and use cases for the internet of things: Hanes, David | Salgueiro, Gonzalo | Grossetete, Patrick | Barton, Robert Henry, Jerome, Pearson, 2018, ISBN: 9789386873743.
5. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning IOT by David Etter,

Video lectures:

1. Introduction to internet of things By Prof. Sudip Misra, IIT Kharagpur
   https://swayam.gov.in/nd1_noc20_cs66/preview
2. https://www.coursera.org/specializations/iot#courses
3. https://www.coursera.org/specializations/embedding-sensors-motors

MOOC course
The Arduino Platform and C Programming
https://www.coursera.org/learn/arduino-platform?specialization=iot#syllabus

Course code	Course Title	Teaching Scheme	
		NA	Credits
PR1101	Automation Project		2

Course Objectives: The course aims to train students for designing and implementing solutions for Automation using Internet of Things.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Design and implement a complete project in IoT using Node-MCU and sensors using Embedded C programs

   Or

   Design and implement a complete project in IoT using Raspberry pi and sensors using Python programs
2. Apply one/more standard protocol(s) during project implementation
3. Demonstrate sensitivity to sustainability issues for power consumption / Bandwidth utilization/economic solutions during implementation of projects**.**

Assessment Scheme:

Sr. No.	Evaluation Component	Marks
1	Attendance	Nil
2	Assignment	Nil
3	Class Participation	Nil
4	Quiz	Nil
5	Theory Exam-I	Nil
6	Theory Exam-II	Nil
7	Theory Exam-III	Nil
8	Report I (Synopsis)	30
9	Report II (Midterm Progress Presentation and Viva)	30
10	Report III	Nil
11	Project I (with Report)	Nil
121	Project II	Nil
13	Project III (With working model)	40
14	Lab Evaluation I	Nil
15	Lab Evaluation II	Nil
16	Course Portfolio	Nil
	Total (100)	**100**
Evaluation scheme for retest.		
	Project III (with Report)	**40**
	Total (100)	**40**

Course code		Course Title	Teaching Scheme			
			L	T	P	Credits
PS1101		Practice School – I				4
Evaluation Scheme						
S. No.	Evaluation Component		Marks (100) (Weightage %)			
1	External Supervisor	Day to Day task Record	30			
		Report Content and Presentation	20			
2	Faculty Supervisor	Reporting Activity Fortnightly	20			
		Presentation, Viv, Report	30			

Syllabus:

This course is for 6 weeks at the end of 4th semester during summer term of 4 year full time B. Tech. and 5 year Integrated Dual degree (B.Tech + M.Tech, B.Tech + MBA) programs in all the engineering disciplines. The objective of this Programme is to provide the students an understanding of working of corporate world in various functions associated with an Industry/Organization. During this Programme, they will observe and learn various real-world applications of their curricula and develop an understanding of vast engineering operations and its various facets such as inventory, productivity, management, information systems, human resource development, data analysis etc. The general nature of PS-1 assignments is of study and orientation.

Course Title and Code	Design of Machine Elements- ME1110		
Hours per Week	**L-T-P: 3-0-2**		
Credits	**4**		
Students who can take	**B. Tech Semester-VI (Batch: 2017-2021)/ Core**		
Course Objective: This course aims to equip students with the concepts, procedure, and standards for designing and evaluating shafts, bearings, springs, and gears for different applications.			
After course completion, the student will be able to: 1. Design and evaluate shafts to work under different service loading conditions as per ASTM/BIS standards. 2. Design bearings for various applications as per ASTM/BIS standards. 3. Design, evaluate gears for various applications as per ASTM/BIS standards. 4. Design springs for various systems as per ASTM/BIS standards.			
Prerequisites	Strength of Materials and Engineering Mechanics.		
Sr. No	**Specifications**	**Marks**	**Marks (Post COVID)**
1	Attendance	NIL	
2	Assignment	10	20
3	Class Participation	NIL	
4	Quiz	10	20
5	Theory Exam I	10	10
6	Theory Exam II	10	
7	Theory Exam-III	30	20
8	Report-I	NIL	10
9	Report-II	NIL	
10	Report-III	NIL	
11	Project-I	10	
12	Project-II	Nil	
13	Project-III	Nil	
14	Lab Evaluation-I	10	10
15	Lab Evaluation-II	10	10
16	Course Portfolio	Nil	
	Total (100)	**100**	**100**

Syllabus (Theory)

UNIT-I

Design for Fluctuating Loads- Theory of failures, cyclic stress, fatigue and endurance limit, stress concentration factor, notch sensitivity, design for finite and infinite Life, Soderberg, Goodman & Gerber criteria.

Shafts- Material for shaft, stresses in shaft, design of shaft subjected to twisting moment, bending moment and combing twisting and bending moments, shaft subjected to fatigue load.

UNIT-II

Bearing- Classification of bearing, hydrodynamic lubrication, sliding contact bearing, design of journal bearing, thrust bearing-pivot and collar bearing, hydrodynamic thrust bearing.

Rolling contact bearing, types of rolling contact bearing, Bearing life, Selection of ball and roller bearings with ABMA Standards.

UNIT-III

Spur Gears- classification of gear, tooth forms, system of gear teeth, design consideration, Beam strength of gear tooth, dynamic tooth load, wear strength of gear tooth, failure of gear tooth, design of spur gears, AGMA standards.

Helical Gears: Terminology, forces components on a tooth of helical gear, virtual number of teeth, beam strength & wear strength of helical gears, dynamic load on helical gears.

UNIT-IV

Springs- Types of springs, design for helical springs against tension, compression and fluctuating loads, Design of leaf springs, Surging phenomenon in springs.

Text Book(s)

1. Joseph Edward Shigley. "Mechanical Engg. Design" Tata Mc Graw Hill Book Co., 2006.
2. Bhandari, V B "Design of Machine Elements" Tata McGraw Hill, New Delhi., 2000.
3. PSG College of Engg. "PSG Design Data Book". PSG Publication.
4. K. Balveera Reddy & K. Mahadevan. "Design Data Handbook". 4th ed. CBS Publishers & Distributors, 497 pages, 2013.

Reference Book(s)

1. Dieter, G.E. and L.C. Schmidt, *Engineering Design*, 5th ed., McGraw-Hill Book Co, 825 pages, 2012.
2. Chitale, A. K., and R. C. Gupta. Product design and manufacturing. PHI Learning Pvt. Ltd., 2011.
3. Norton, Robert L. Machine Design An Integrated Approach. Pearson., 2006.
4. Kulkarni, S G . Machine Design. New Delhi: Tata Mcgraw Hill., 2008.

Syllabus (Lab)

1. Design an Oldham coupling and develop a 3D model.
2. Design a roller bearing and develop a 3D model.
3. Design a sliding contact bearing and develop a 3D model.
4. Design a spur gear and develop a 3D model.
5. Design a helical gear and develop a 3D model.
6. Design of spring under given condition and develop a 3D model.

Course Title and Course Code	**Automobile Engineering (ME1111)**
Hours per Week	**L T P: 3 0 2**
Credits	**4**
Students who can take	**B. Tech Semester-VI**

Course Objective:

The main objective of the course is:-

1. To make the student conversant with fundamentals of automotive systems
2. To develop competencies in performance analysis of vehicles

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Identify different part of the automobile.
2. Design and explain the working of various parts like engine, transmission, clutch and brakes.
3. Design a steering and suspension system.
4. Identify Euro6 standards for automobile emissions.

Prerequisites		**Thermodynamics**
Sr. No	**Specifications**	**Marks**
1	Attendance	0
2	Assignment	20
3	Class Participation	NIL
4	Quiz	5
5	Theory Exam-I	25
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	NIL
Total (100)		**100**
Evaluation scheme for Retest		**Marks**
1	Theory Exam-Retest	**30**
	Total(30)	**30**

UNIT-I **(10 Hours)**

Introduction: Layout of automobile – introduction chassis and body components. Types of Automobile engines. – Power unit – Introduction to engine lubrication – engine servicing

Fuel System: S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. Introduction to MPFI and GDI Systems.

C.I. Engines: Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. Fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Introduction CRDI and TDI Systems.

Unit II **(10 Hours)**

Cooling System: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporative cooling – pressure sealed cooling – antifreeze solutions.

Ignition System: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

Electrical System: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

UNIT-III **(10 Hours)**

Transmission System: Manual transmission and types of gear box, sliding-mesh, constant-mesh and synchromesh gear boxes, types of dog clutches, gear shift mechanism, principles of automatic transmission. Clutch operation and types, multi-plate and cone clutches, clutch construction and lining. Propeller shafts, universal joints, slip joint, Hotch-Kiss drive and torque tube drive, transaxle and transfer case, radius rods, four wheel drive arrangement. Automobile emissions, their harmful effects, pollution control measures, catalytic converters, exhaust system layout, mufflers, and resonators. Engine parameters, brief discussion of testing devices, engine service, engine tuning, engine re-boring, cyaniding, nitriding, de-carbonization.

UNIT-IV **(10 Hours)**

Braking System: Braking systems, layouts for mechanical braking, hydraulic braking, pneumatic braking, master cylinder, wheel cylinder, tandem cylinder, shoe brakes, disc brakes, requirements of brake fluid, power brakes, concept of ABS and traction control, parking brakes. Steering system, principles and need of steering, components parts, steering gear, steering ratio, steering lock, turning radius, centre point. Steering, wheel geometry, power steering principle and typical schemes.

Suspension System: Suspension system, functions of suspension, component parts, coil springs, leaf springs, air springs, shock absorbers, torsion bars, stabilizer bars, typical combinations of components in suspension systems, MacPherson strut suspension, its merits.
Wheel and tyres, wheel assembly and parts, pressed wheels and cast wheels, wheel rim, tyres, aspect ratio, tyres with tubes and tubeless tyres, advantages, construction of a tyre, plies, radial plies, tyre treads and tyre specifications.

Text Books:

1. Automotive Chassis- Heldt .P. M, Chilton Co., (Nyack, N.Y., P.M. Heldt, 1945) Literary Licensing, LLC, 2012.
2. Automotive Mechanics- N.K. Giri, 8th Edition, Khanna Publications, New Delhi, 2008.
3. Automobile Engineering / William H Crouse
4. Text Book Automobile Engineering–Manzoor, .Nawazish Mehdi & .Yosuf Ali, Frontline Publications.
5. Kamaraju Ramakrishna, "Automobile Engineering", PHI Learning, New Delhi, 1st Print, 2012.
6. Jain &Asthana, "Automobile Engineering", Tata McGraw-Hill, New Delhi, 2002.

Reference Books:

1. Text Book of Automobile Engineering by R K Rajput. Laxmi Publications.
2. Automotive Mechanics / Heitner
3. Automotive Engineering / Newton Steeds & Garrett
4. Automotive Engines / Srinivasan
5. Text Book of Automobile Engineering By Khalil U Siddiqui New Age International
6. Heinz Heisler, "Advanced Vehicle Technology", Elsevier, New Delhi, 2011.
7. Crouse &Anglin, "Automotive Mechanics", Tata McGrawHill, New Delhi, 10th Edition 2007.

Course Title and Code: Critical Thinking for Decisions at Workplace |CC1106			
Course Description: In today's world, the idea of right and wrong is being challenged by businesses, use of technology, economic conditions, and norms of societies. The relevance of a well-reasoned decision is crucial. This course intends to make students take better decisions keeping in mind purpose, context, and ethics. **Learning Outcomes** The students will be able to: 1. Apply techniques of critical thinking to analyse organisational problems through positive inquiry 2. Describe and analyse appropriate problem-solving and ethical decision-making processes 3. Choose the most effective and logical decision among multiple alternatives 4. Evaluate solutions and anticipate likely risks based on purpose, context and ethics			
Prerequisites		**N/A**	
Hours per Week		**L-T-P: 2-0-0**	
Credits		**2**	
Sr. No	**Specifications**	**Weightage**	
		Original	**Revised**
1	Attendance	Nil	10
2	Assignment	20	30
3	Class Participation	20	10
4	Quiz	Nil	-
5	Theory Exam-II	20	15(Individual viva)
6	Theory Exam-III	30	15 (online mode)
	Presentation	20	20
	Total (100)	100	**100**

References for Readings:

1. Lehrer, J. (2010). How we decide. Houghton Mifflin Harcourt.
2. Heath, C., & Heath, D. (2013). Decisive: How to make better choices in life and work. Random House.
3. Hammond, J. S., Keeney, R. L., & Raiffa, H. (2015). Smart choices: A practical guide to making better decisions. Harvard Business Review Press.
4. Cases and scenario will be shared in the class.

Course Title and Code: Minor Project (PR1103)	
Prerequisites	**Nil**
Hours per Week	**L-T-P:**
Credits	**04**
Students who can take	**B.tech. Semester VII**

Course Objective:

In Minor Project, Students are expected to work towards the goals and milestones set in Minor Project. The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. At the end there would be a demonstration of the solution and possible future work on the same problem. The student will have to present the progress of the work through seminars and progress reports. (in continue contact with Faculty Supervisor Assigned)

Operation Procedure

- Student has to devote full semester for Minor Project.
- Student has to report to the Supervisor regularly.
- Seminars s evaluation has to be carried out in the presence of atleast two-member Committee comprising.
- Experts in the relevant area constituted by the Supervisor.
- Final Seminar Report to be submitted has to be in formal hard bound cover bearing of the Institute emblem.

Assessment Scheme:

Sr. No	**Specifications**	**Marks**
01	Attendance	NIL
02	Assignment	NIL
03	Class Participation	NIL
04	Quiz	NIL
05	Theory Exam(Mid Term)	NIL
06	Theory Exam	NIL
07	Theory Exam(Final)	NIL
08	Report-1 (Synopsis) (Panel)	15
09	Report-2	NIL
10	Report-3	NIL
11	Project -1 (Mid Term) (Panel)	20
12	Project -2 (Day to Day work) (Demo, Presentation, Viva, Report)	25
13	Project -3 (End Term) (Panel) (Demo, Presentation, Viva, Report)	40
14	Lab Evaluation – I	NIL

15	Lab Evaluation – II	NIL
16	Course portfolio	NIL
	Total (100)	**100**

PS1102/ PR2107/ PR1105/ PR1104**:**

Practice School-II/ Industrial Project-II / Entrepreneurial Project/ Research Project

Course Syllabus:

This course is for five four and half months (summer and one semester) in VII or VIII Semester. The objective of this programme is to provide the students, an opportunity to work on live projects of corporate world in various fields. During this programme, they will work on real world applications of their curricula through organizational function of their choice. The students are expected to be involved directly in problem solving efforts of specific interest to the host organization. The learning of PS-I will help them in completing PS-II successfully. PS-II duration of internship is 4 - 4.5 months. PS -II Winter internship Dec to May.

Course Code	**Course Title**	**Teaching Scheme**	
		Total Duration	**Credits**
PS1102/ PR2107/ PR1105/ PR1104	**Practice School-II/ Industrial Project-II/ Entrepreneurial Project/ Research Project**	**4 months**	**16**

Evaluation Scheme:			
Expert Evaluation	**Evaluation Component**	**Mid-Term**	**Final Term**
Industry Expert	Day to Day Task Record	20	40
	Report Content & Presentation	10	30
JKLU faculty	Reporting Activity Fortnightly	8	18
	Presentation, Viva, Report	20	50
	PS-2 Coordinator Feedback	2	2
	Total	**60**	**140**

Program Education Objectives

The BTech Programs at IET, JKLU are designed to prepare students for continued learning and successful careers. Our alumni are expected to:

PEO1: Apply their technical knowledge, complex problem solving and research skills in professional practice.

PEO2: Continue their intellectual development through critical thinking, self- study, apprenticeship, higher education, professional development courses, as well as participation in research groups and professional networks.

PEO3: Serve as ambassadors for engineering and sustainability by exhibiting high professional standards with a deep sense of civic responsibility.

PEO4: Effectively communicate about technical and related issues.

PEO5: Embrace roles of team members and leaders in their career.

Program Outcomes

The graduates of BTech Programs at IET, JKLU will have following competencies:

PO 1: *Life-long learning:* Demonstrate inquisitiveness, open mindedness, and the ability to engage in independent and life-long learning in the broadest context of technological, organizational, economic, and societal changes.

PO 2: Citizenship, Sustainability, and Professional ethics

PO 2a: Demonstrate knowledge of constitutional values of liberty, equity, justice, and fraternity with understanding of the impact of the engineering solutions in societal and environmental contexts as well as a sense of responsibility for sustainable development.

PO 2b: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, cultural, and environmental issues and the consequent responsibilities relevant to the professional engineering practice.

PO 2c: Demonstrate commitment for professional integrity and excellence and respect for ethics, responsibilities and norms as prescribed for the engineering practice.

PO 3: Engineering knowledge and Modern tool usage

PO 3a: Demonstrate clear conceptual understanding of fundamentals of engineering specialization and cognitive flexibility to appropriately 'transfer' what has been learned in a context, to different situations.

PO 3b: Apply engineering thinking, computational thinking, and the knowledge of mathematics, natural and social sciences, engineering fundamentals, information

technology, engineering specialization, and engineering management to the solution of complex engineering problems.

PO 3c: Create, select, modify, and apply appropriate techniques, best practices, standards, resources, and modern engineering and IT tools including prediction and modelling to engineering and social activities with an understanding of the limitations.

PO 4: Complex problem solving, Design and Research

PO 4a: Identify, formulate, review research literature, and analyze complex engineering problems to arrive at substantiated conclusions using critical thinking along with principles of mathematics, computing, engineering as well as natural and social sciences.

PO 4b: Use systems thinking and reflection to identify and consider underlying structures, patterns, volatility, uncertainties, complexities, ambiguities, complications, and risks to design and develop engineering solutions for complex problems to meet the specified and anticipated needs with appropriate concern for constraints, performance, sustainability, and professional ethics.

PO 4c: Use research-based knowledge and research methods including design of experiments, simulation, analysis and interpretation of data, and synthesis of the information to evaluate and improve the engineering solutions and practice.

PO 5: Individual & teamwork and Engineering management

PO 5a: Ability to work effectively as an individual and as a team member or leader in diverse and distributed teams, and in multidisciplinary settings.

PO 5b: Ability to apply engineering management principles to one's own and team's work to manage engineering projects and operations and in multidisciplinary environment.

PO 6: Communication: Ability to communicate effectively on complex engineering and technology activities, situations, problems, and solutions using verbal, textual, and pictorial elements with the colleagues, engineering community, users, clients, policy makers, and society at large with intellectual honesty, clarity, empathy, and compassion.

PO 7: Innovation and entrepreneurship:

PO 7a: Demonstrate enthusiasm and understanding to identify opportunities and translate research in engineering and other disciplines to conceive and design innovative engineering solutions for business, industry, and societal problems.

PO 7b: Demonstrate enthusiasm and understanding to conceive and plan technology based new ventures either as independent start-up businesses or within existing corporate structures.

Program Specific Outcomes

B.Tech. (Mechanical Engineering)

The Mechanical Engineering graduates of JKLU will be able to:

MEPSO1:

Conceive, design, implement, and manage mechanical systems, components, and processes by using principles of machine design, production engineering, thermal engineering, computing, automation, sustainability and contemporary materials and tools.

MEPSO2:

Serve in fields of engineering services, manufacturing, automobile, energy, EPC and mechatronics.

JK Lakshmipat University, Jaipur
Institute of Engineering and Technology
Department of Mechanical & Engineering
Course Structure for the B. Tech (Batch 2019-2023)

Sem	Courses							Credits
I	Computational Data Analysis	Design and Prototyping	Experimental Science-I	Fundamentals of Communication				**21**
	ES1101	**ES1102**	**AS1101**	**CC1101**				
	(10s 2 0)	**(6s 0 0)**	**(1 0 4)**	**(2 0 1)**				
	10	**6**	**3**	**2**				
II	Calculus and Applied Mechanics	Fundamentals of Automation Engineering	Object Oriented Programming (Java + Simple Database)/ Python Programming	Energy and Environmental Studies	Critical Thinking and Storytelling	Scientific Perspectives (Science Week)		**20**
	ES1103	**ES1104**	**CS1101 / CS1301**	**ES1105**	**CC1102**	**AS1102**		
	(6s 2 0)	**(6s 2 0)**	**(1 0 4)/(0 2 0)**	**(1 0 0)**	**(2 0 1)**			
	6	**6**	**3**	**1**	**2**	**2**		
III	Materials Engineering	Computational Engineering Analysis-I	Engineering Measurements and Machines	Engineering Thermodynamics	Perspectives on Contemporary Issues	Management Perspectives (Management Week)		**22/25***
	ME1101	**ES1106**	**ES1107**	**ME1102**	**CC1103**	**IL1101**		
	(3 0 2)	**(3 1 2)**	**(3 0 4)**	**(3 0 2)**	**(2 0 1)**			
	4	**5**	**5**	**4**	**2**	**2**		
IV*	**Transport Phenomena**	**Strength of Materials and Analysis**	**Computational Engineering Analysis-II**	**Production Technology-I**	Communication and Identity	Intoduction to Design (Design Week)	Mechanical Engineering CAD lab	**23/24***
	ME1104	**ME1105**	**ES1109**	**ME1106**	**CC1104**	**IL1102**	**ME1107**	
	(3 0 2)	**(3 0 2)**	**(3 1 2)**	**(3 0 2)**	**(2 0 1)**		**(0 0 4)**	
	4	**4**	**5**	**4**	**2**	**2**	**2**	
Practice School - I (PS1101) – (4 to 6 Weeks Duration) - 4 Credits								
V*	Theory of Machine	Production Technology- II	DE-1	OE-1	Understanding and Managing Conflict	Introduction to IoT	Automation Projects	**22**
	ME1108	**ME1109**			**CC1105**	**EE1111**	**PR1101**	
	(3 0 2)	**(3 0 2)**			**(2 0 0)**			
	4	**4**	**4**	**4**	**2**	**2**	**2**	
VI*	Design of Machine Elements	DE-II	Automobile Engineering	DE-III/ OE -II/ Minor Project	Critical Thinking for Decisions at Workplace	Emerging Tech Week		**20**
	ME1110		**ME1111**		**CC1106**			
	(3 0 2)	**(3 0 2)**	**(3 0 2)**		**2**	**2**		
	4	**4**	**4**	**4**	**2**	**2**		
VII*	DE-4	DE-5	DE-6	OE-3	Minor Project			**20**
					PR1103			
	4	**4**	**4**	**4**	**4**			
VIII*	Practice School - II /Entrepreneurial Project/Research Project/Semester at a partner University							**16**
							Total Credits	**165-166***

Course Code: AS1101

Course Name: Experimental Science-I

Course Outcomes: On successful completion of this course, the students will be able to:

AS1101.1. analyze ferromagnetic properties of any magnetic material and differentiate Soft and hard materials.
AS1101.2. analyze thermoelectric effect of metal junctions due to temperature differences.
AS1101.3. analyze nuclear radiation with respect to distance and thickness of absorbing media.
AS1101.4. measure electrical properties e.g., specific resistance, time constant of various electrical components.
AS1101.5. use Schroedinger equation and quantum mechanical approach to analyze behavior of the quantum particle under different potentials.
AS1101.6. differentiate hard and soft water by determining its hardness of different water samples.
AS1101.7. analyze conductivity of samples by different techniques such as volumetric titrations and conductometric.
AS1101.8. determine properties of the lubricant/oil samples by Pensky-Martens and Red Viscometer.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
AS1101.1	1				1									1			
AS1101.2	1																
AS1101.3	1										1						
AS1101.4	1				1						1						
AS1101.5	1																
AS1101.6	1		1		1	1	1				1		1		1		
AS1101.7	1		1				1				1		1				
AS1101.8	1																

Course Code: CC1101

Course Name: Fundamentals of Communication

Course Outcomes: After course completion, the student will be able to:

CC1101.1. Identify different cultural differences and their impact on communication.
CC1101.2. Compose grammatically correct sentences and paragraphs.
CC1101.3. Deliver effective oral presentations following appropriate kinesics and paralinguistic features.
CC1101.4. Identify impact of cultural differences on communication.
CC1101.5. Apply appropriate communication skills across settings, purposes, and audiences.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
CC1101.1									1		1		1				
CC1101.2																	
CC1101.3	1										1						
CC1101.4																	
CC1101.5	1										1		1				

Course Code: ES1101

Course Name: Computational Data Analysis

Course Outcomes: After course completion, the student will be able to

ES1101.1. Write Simple Python programs using various datatypes, control structures, decision statements, libraries, functions (M1)
ES1101.2. Develop Python programs using Objects, Classes and Files (M1, M2)
ES1101.3. Develop Programs for analyzing and interpreting Complex situations in various domains including sustainable development by combining various Linear Algebra, Statistics and Other Problem-Solving Techniques (M3)
ES1101.4. Model Complex systems as Linear simultaneous equations and analyze the same using Matrix methods (M1)
ES1101.5. Model Data as matrices and Find Eigen Values and Eigen Vectors and Apply the same for problem solving, e.g., ranking and performance analysis (M1)
ES1101.6. Summarize and Visualize different datasets (M2)
ES1101.7. Analyze and interpret different datasets using Discrete and Continuous Probability Distributions and Apply the same for problem solving, e.g., Goodness of Fit (M2)
ES1101.8. Formulate and validate hypothesis with reference to different datasets (M2)
ES1101.9. Apply correlation, regression, least square method and time series analysis for modeling, analysis, interpretation, and forecasting (M2)

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO -1	PSO-2
ES1101.1																	
ES1101.2											1						
ES1101.3					1	1					1			1			
ES1101.4			1		1	1				1	1						
ES1101.5			1		1	1				1	1			1			
ES1101.6					1	1		1			1		2				
ES1101.7		1	1		1	1		1			1		1	1			
ES1101.8		1	1		2	1		2			1		1	1			
ES1101.9		1	1		2	1		2		1	1		1	1			

Course Code: ES1102

Course Name: Design and Prototyping

Course Outcomes: After course completion, the student will be able to

ES1102.1. Approach design challenges from the perspective of the user and offer innovative solutions effectively.
ES1102.2. Communicate and work in team towards a common goal.
ES1102.3. Think creatively towards a fun based, desirable solution.
ES1102.4. Develop the projection views of the products with dimensions and scales.
ES1102.5. Create the schematic diagram and isometric view of the parts using AutoCAD.
ES1102.6. Fabricate prototype by combining the different parts.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
ES1102.1	2	1	1	1										2			
ES1102.2											1	1	1				
ES1102.3	2				2	1	1	1						2			
ES1102.4					1	1	1										
ES1102.5	1				2	1	1										
ES1102.6	2				2	1	1				1	1	1				

Course Code: AS1102

Course Name: Scientific Perspectives

Course Outcomes: After course completion, the student will be able to

AS1102.1. Distinguish between science, pseudo-science and other forms of knowledge.
AS1102.2. Distinguish between science, engineering, technology and mathematics and also identify the opportunities for integrating these disciplines.
AS1102.3. Use the scientific approach to identify and understand the societal problems
AS1102.4. Explain, Design and carry out Scientific studies

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
AS1102.1	1												1				
AS1102.2					1	1											
AS1102.3		1			1												
AS1102.4	1												1				

Course Code: CC1102

Course Name: Critical Thinking & Storytelling

Course Outcomes: On successful completion of this course, the student should be able to:

CC1102.1. Formulate intelligent questions to investigate.
CC1102.2. Evaluate information and argument for correctness, consistency, relevance, and validity.
CC1102.3. Compose well-structured and well-reasoned arguments.
CC1102.4. Articulate and evaluate the impact of narratives.
CC1102.5. Distinguish between facts, assumptions and opinion.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
CC1102.1			1					1									
CC1102.2			1			1							1				
CC1102.3											1						
CC1102.4													1				
CC1102.5													1				

Course Code: CS1101

Course Name: Object Oriented Programming

Course Outcomes: On successful completion of this course, the students should be able to:

CS1101.1. Develop Java Programs with the concepts of primitive data types, strings and arrays.

CS1101.2. Develop Java Programs using Object Oriented Programming Principles such as Classes, Objects, Data Abstraction, Data Encapsulation, Overloading, Overriding, Polymorphism, Inheritance, and Interfaces.

CS1101.3. Design, develop and debug programs in Core Java using coding and documentation standards.

CS1101.4. Incorporate exception handling in Java Programs.

CS1101.5. Use JDBC API connectivity in between Java Programs and database.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
CS1101.1					1	1	1							1			
CS1101.2																	
CS1101.3					1	1					1	1		1			
CS1101.4																	
CS1101.5											1	1					

Course Code: CS1301
Course Name: Python Programming

Course Outcomes: On successful completion of this course, the student should be able to:

CS1301.1. Design and program the standalone Python applications.
CS1301.2. Use lists, tuples, and dictionaries in Python programs.
CS1301.3. Identify Python object types.
CS1301.4. Design structure and components of a Python program.
CS1301.5. Use Python Control and Decision-making Structures for writing programs
CS1301.6. Write long iterative programs into recursive code.
CS1301.7. Build programs that related to text analytics.
CS1301.8. Build small graphics and animation programs.
CS1301.9. Design machine learning model to perform data analysis.
CS1301.10. Build own Python packages or modules for reusability.
CS1301.11. Read and write files in Python.
CS1301.12. Use Data Handling Techniques of Python
CS1301.13. Use exception handling in Python applications for error handling, find syntax errors

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO-2
CS1301.1	1																
CS1301.2											1						
CS1301.3							1										
CS1301.4																	
CS1301.5										1							
CS1301.6																	
CS1301.7							1									1	
CS1301.8			1														
CS1301.9						1											
CS1301.10			1														
CS1301.11																	
CS1301.12									1								
CS1301.13													1				

Course Code: ES1103

Course Name: Calculus and Applied Mechanics

Course Outcomes: After course completion, the student will be able to

ES1103.1. apply analytical techniques to determine forces in structures
ES1103.2. use commercial software (STAAD Pro.) to simulate a structure/frame and determine force in the members
ES1103.3. model physical phenomena using calculus and solve using appropriate method
ES1103.4. apply Newton's laws of motion and understand the concepts of dynamics concepts (force, momentum, work and energy)
ES1103.5. interpret the geometrical significance of differential and integral calculus
ES1103.6. solve problems of vector differentiation and integration
ES1103.7. calculate the buoyant forces of objects with various shape and carryout the stability analysis
ES1103.8. apply the concept of partial differentiation to solve optimization problems

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
ES1103.1						2					1		2				
ES1103.2						2	2				1						
ES1103.3	1				1	2	2		1		2		1				
ES1103.4	2				1	2	2				1						
ES1103.5	1				1	2	2										
ES1103.6						1	1										
ES1103.7						1	1		1		1		2				
ES1103.8						2	1				1		1				

Course Code: ES1104

Course Name: Fundamentals of Automation Engineering

Course Outcomes: On successful completion of this course, the students should be able to:

ES1104.1. Analyze electrical circuits using network theorems,
ES1104.2. Measure electrical parameters of passive as well as active electrical components,
ES1104.3. Design rectifier circuit using semiconductor devices,
ES1104.4. Design filters for power conditioning,
ES1104.5. Design and test a linear power supply for given specifications,
ES1104.6. Design and build Printed Circuit Boards,
ES1104.7. Use electrical safety practices while working on electrical projects,
ES1104.8. Formulate mathematical models for basic electro-mechanical systems,
ES1104.9. Design and simulate a basic analog open-loop control system,
ES1104.10. Evaluate and simplify Boolean functions and implement the minimized logic using logic gates,
ES1104.11. Implement and test basic combinational and sequential circuits with minimum complexity,
ES1104.12. Implement various logic functions using software programming with micro controller, so as to make optimal utilization of resources,
ES1104.13. Identify the key features of embedded systems in terms of hardware and software
ES1104.14. Interface sensors and design low power embedded systems projects using microcontroller

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
ES1104.1.					2			1									
ES1104.2.						2								1			
ES1104.3.					1			1									
ES1104.4.					2							1		1			
ES1104.5.					1							1		1			
ES1104.6.							1		1			1		1			
ES1104.7.	2						2						1				
ES1104.8.	2				2			2						2			
ES1104.9.					1							1		1			
ES1104.10.																	
ES1104.11.	2				2							1					
ES1104.12.						2			2			1	1	1			
ES1104.13.					2			1									
ES1104.14.						2								1			

Course Code: ES1105

Course Name: Energy and Environment Studies

Course Outcomes: On successful completion of this course, the student should be able to:

ES1105.1. Relate renewable energy with ecology & environment
ES1105.2. Explain the climate change and threat to biodiversity
ES1105.3. Describe the various pollution sources and their impacts on Environment

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
ES1105.1	1					1											
ES1105.2		1									1						
ES1105.3	1				1												

Course Code **:** ME1101
Course Name **:** Materials Engineering

Course Outcomes **:**

ME1101.1. Identify crystal structure, crystal defects and perform various mechanical tests as per ASTM standards to know properties of materials.
ME1101.2. Evaluate materials on the basis of their static and dynamic failure criteria as per ASTM standards.
ME1101.3. Perform various heat treatment processes to hold required mechanical properties in ferrous alloys.
ME1101.4. Prioritize other ferrous and non-ferrous alloys for various applications.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO-2
ME1101.1					1	1	1					1				1	1
ME1101.2					1	1		1	1		1	1				1	1
ME1101.3	1				1	1	1	1	1							1	2
ME1101.4	1				1	1		1	1		1	1				1	1

Course Code: ES1106

Course Name: Computational Engineering Analysis – I

Course Outcomes: On successful completion of this course, the students will be able to:

ES1106.1. Solve ordinary differential equations through various techniques.
ES1106.2. Determine the structural behavior of the body by determining the stresses, strains produced by the application of load.
ES1106.3. Analyze the concept of buckling and be able to solve the problems related to column and struts.
ES1106.4. Model the problems of column and struts mathematically in terms of ordinary differential equations and solve them using the appropriate method.
ES1106.5. Simulate the solutions of the above-mentioned models of columns and struts.
ES1106.6. Analyze a function of complex variables in terms of analyticity, poles and zeroes.
ES1106.7. Find Laplace and inverse Laplace transforms of given function and use Laplace transform to solve ordinary differential equations.
ES1106.8. Design and Evaluate the LC, RC & RL Networks using Foster'sand Cauer Forms
ES1106.9. Analyze stability criteria for electrical network using pole zero plot and routh-hurwitz polynomials
ES1106.10. Model and simulate electrical networks using Proteus simulator/ Virtual lab.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
ES1106.1					2	2	2	1	1		1	1					
ES1106.2					2			2									
ES1106.3					1			1							1		
ES1106.4		1			1	2	2	1	1	1	2	1					
ES1106.5							2	1		1							
ES1106.6					2												
ES1106.7					2	2	1	1	1		1	2					
ES1106.8					2	2		2			1	1		1			
ES1106.9					2	2		1			1	1					
ES1106.10	1						1		1								

Course Code: ES1107

Course Name: Engineering Measurements and Machines

Course Outcomes: On successful completion of this course, the students be able to:

ES1107.1. Evaluate suitable electrical and non-electrical instruments for measuring physical quantities.

ES1107.2. Analyze the construction, characteristics and applications of various types of rotating machines.

ES1107.3. Analyze the working of any mechanical and electrical machine using mathematical model.

ES1107.4. Integrate the sensors for monitoring and automation of electrical and mechanical systems.

ES1107.5. Design electro-mechanical machines as per Indian standards.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
ES1107.1	2				2	1	1				1	1	1	1			
ES1107.2		1			1	1	1	1									
ES1107.3					1	2	1	1	1		1						
ES1107.4	1	1	1		1	1	1	1	1		1		1				
ES1107.5	1		1	1	1	1	1	1	1		1	1					

Course Code : ME1102
Course Name : Engineering Thermodynamics
Course Outcomes :

ME1102.1. identify the basic thermodynamic processes in our day to day life and industrial processes

ME1102.2. judge the state of the pure substances such as compressed liquid, saturated liquid-vapor mixture and superheated vapour using property diagrams and tables.

ME1102.3. apply the first law of thermodynamics to analyse the working of the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow

ME1102.4. construct energy and mass balance for unsteady-flow processes.

ME1102.5. assess thermodynamic applications using second law of thermodynamics to power and refrigeration cycle.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO-2
ME1102.1	1				1			1								2	2
ME1102.2					1											2	2
ME1102.3	1					1	1			1		1	1	1		2	2
ME1102.4		1			1	1		1								2	2
ME1102.5			1		1		1					1	1			2	2

Course Code: CC1103

Course Name: Perspectives on Contemporary Issues

Course Outcomes: After course completion, the student will be able to

CC1103.1. Identify different perspectives objectively.
CC1103.2. Explain interconnectedness of the issues and their impact at micro and macro levels.
CC1103.3. Recognize their own beliefs, biases, claims and assumptions.
CC1103.4. Evaluate sources, argue and defend effectively.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
CC1103.1	1		1					1			1	1					
CC1103.2						1					1	1	1				
CC1103.3											1	1	1				
CC1103.4	1		1									1	1				

Course Code: IL1101

Course Name: Management Perspectives

Course Outcomes: After course completion, the student will be able to

IL1101.1. Comprehend the importance of management and its functional areas in businesses and also its interaction with technology.

IL1101.2. Highlight specific external and internal issues impacting businesses.

IL1101.3. Integrate and analyze multiple dimensions of management aspects to solve business problems.

IL1101.4. Evaluate the aspects that management might consider when evaluating technical and engineering projects such as planning and scheduling, personnel management, cost control etc. from a management perspective

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
IL1101.1	0.5				0.2												
IL1101.2	0.5	1											0.5				
IL1101.3	1		0.2		0.2						1		0.5				
IL1101.4	1			0.2							1	2					

Course Code **:** ME1104
Course Name **:** Transport Phenomena

Course Outcomes **:**

ME1104.1. identify the basic transport processes in our day to day life and industrial processes
ME1104.2. apply the continuity, momentum and energy principles and dimensional analysis
ME1104.3. formulate and analyse a heat transfer problem involving any of the three modes of heat transfer
ME1104.4. apply the appropriate correlations to calculate heat transfer coefficient and heat flux for a range of heat transfer situations (Steady and unsteady)
ME1104.5. design and model a real life low energy heat transfer equipment as per ASME standard
ME1104.6. analyse the combined effect of heat, mass and momentum transport in a typical chemical engineering equipment (heat exchanger, catalyst bed, chemical reactor, etc.)

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO-2
ME1104.1	1				1		1	1								2	
ME1104.2					1	1		1								2	2
ME1104.3	1				1		1	1		1						2	2
ME1104.4		1						1				1				2	2
ME1104.5		1				1						1	1	1		2	2
ME1104.6	1		1		1							1	1	1		2	2

Course Code **:** ME1105
Course Name **:** Strength of Materials and Analysis

Course Outcomes **:**

ME1105.1. identify stress and strain present in a mechanical system.
ME1105.2. analyze and evaluate 1-D and 2-D stress tensor in a specimen.
ME1105.3. analyze shear force and bending moment diagrams for a beam under different loading conditions.
ME1105.4. design shafts against torsion load for different application.
ME1105.5. design columns against buckling load for various end conditions.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO-2
ME1105.1			1		1	1										1	
ME1105.2			1		2	1											
ME1105.3	1		1		1	1											
ME1105.4			1		1												
ME1105.5	1		1		1											1	1

Course Code: ES1109

Course Name: Computational Engineering Analysis – II

Course Outcomes: After course completion, the student will be able to

ES1109.1. Classify various types of partial differential equations and solve them through various analytical and numerical methods.
ES1109.2. Formulate and analyze differential equations especially Navier stokes and energy equations and use numerical methods for solving the same.
ES1109.3. Use Numerical method for solving partial differential equations using finite difference method.
ES1109.4. Find Fourier and inverse Fourier transforms of given function and use Fourier transform to solve partial differential equations.
ES1109.5. Find Z-transform and inverse Z-transforms of given functions and use them to analyze control systems.
ES1109.6. Design and analyse various types of filters and attenuators to minimize power losses and improve signal quality.
ES1109.7. Solve problems involving vertex and edge connectivity, planarity and crossing numbers.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
ES1109.1	1				1	1		1			1						
ES1109.2	2		2		2	2	1	2			1		1	2			
ES1109.3						1	2										
ES1109.4					2	2		1			1						
ES1109.5	1		1		2	2		1			1			1			
ES1109.6		1				1	2			2				1			
ES1109.7						1	2	2						1			

Course Code **:** ME1106
Course Name **:** Production Technology - I

Course Outcomes **:**

ME1106.1. Design molding system to obtain defect free cast.
ME1106.2. Analyze various welding processes for different applications.
ME1106.3. Identify non-conventional manufacturing process to manufacture intricate shaped product accurately.
ME1106.4. Identify latest manufacturing systems and processes for manufacturing of components.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO-2
ME1106.1	1				1	1	1	1	1	1	1	1		1	1	1	2
ME1106.2	1					1	1	1	1	1		1				1	2
ME1106.3											1	1					1
ME1106.4	1				1	1	1										1

Course Code: CC1104

Course Name: Communication and Identity

Course Outcomes: After course completion, the student will be able to

CC1104.1. Analyse their personal identities, both private and social
CC1104.2. Identify their different values, strengths and areas of professional interest
CC1104.3. Articulate their personal statement and use it to craft an influential pitch
CC1104.4. Express themselves through various communication formats on different platforms

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
CC1104.1													1	1			
CC1104.2	1		2	1										2			
CC1104.3													1				
CC1104.4													2				

Course Code: IL1102

Course Name: Introduction to Design

Course Outcomes: After course completion, the student will be able to

IL1102.1. Identify the user and build persona of the
IL1102.2. Sketch their ideas on paper to visualize and assess viability.
IL1102.3. Create a plan for process and management to materialize the desired idea.
IL1102.4. Test the material for possibilities and capabilities.
IL1102.5. Develop skills of joinery, material manipulation and various hand tools.
IL1102.6. Develop technical and narrative skills useful for both film and animation.
IL1102.7. Develop troubleshooting and problem-solving skills.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
IL1102.1	1								1	1			1	1			
IL1102.2	2						1						2				
IL1102.3	1						1	1						2			
IL1102.4	1						1	1									
IL1102.5							1	1									
IL1102.6	2						1						1				
IL1102.7	1		1			1	1										

Course Code **:** ME1107
Course Name **:** Mechanical Engineering CAD Lab

Course Outcomes :

ME1107.1. identify surface roughness number and symbol, symbols of machine elements and welded joints limit.
ME1107.2. assess limits, fits and tolerance for machine elements in engineering drawings.
ME1107.3. develop geometrical models for different machine components.
ME1107.4. develop assembly and detailed drawings of engine parts.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO-2
ME1107.1																	1
ME1107.2									1							1	
ME1107.3									1		1						
ME1107.4							1		1		1		1				1

Course Code **:** ME1108
Course Name **:** Theory of Machines

Course Outcomes :

5. Compare and develop various application based linkages and mechanisms
6. Analyze velocity and acceleration polygon of different types of mechanisms.
7. Analyze the cam and follower mechanism in order to optimize the power consumption.
8. Prioritize among various mechanisms like belt, rope and chain drive systems in order to minimize energy consumption.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO-2
ME1108.1	1				1	1	1				1	1		1		2	2
ME1108.2	1				1	1	1		2			1		1		2	2
ME1108.3	1				1	1	1	1	1					1		2	2
ME1108.4	1				1	1	1	1	1		1	1		1	2	2	1

Course Code : ME1109
Course Name : PRODUCTION TECHNOLOGY - II
Course Outcomes :

5. Design load capacity of forming equipment to perform various bulk forming and sheet forming operations.
6. Design of machining tools, forming tools and holding tools for various forming and machining processes.
7. Calculate force required for machining metallic materials using appropriate cutting tool materials and cutting fluids.
8. Use cutting, milling, and finishing operations to shape materials and evaluate their surface finish using conventional and automatic machines.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO-2
ME1109.1	1				2	1	1	1	1	1				1	1	2	2
ME1109.2					1	1	1	1	1	1				1		2	2
ME1109.3	1				2	1	1	1	1	1				1	1	2	1
ME1109.4					1	1	1	1	1	1				1		2	1

Course Code: CC1105

Course Name: Understanding and Managing Conflict

Course Outcomes: After course completion, the student will be able to

CC1105.1. Define a group and explain the stages of group development
CC1105.2. Describe conflict and explain types and causes of conflict
CC1105.3. Use inquiry and advocacy to engage with groups
CC1105.4. Give and receive feedback effectively
CC1105.5. Identify sources of conflict and manage them using difference conflict handling styles

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
CC1105.1	1										2		1				
CC1105.2	1							1									
CC1105.3	1		1						1		2	1	1				
CC1105.4	1										1		1				
CC1105.5	1										1	1	1				

Course Code: EE1111

Course Name: Introduction to IoT

Course Outcomes: On successful completion of this course, the students should be able to:

EE1111.1. Interface the Analog and Digital sensors to Node-MCU
EE1111.2. Develop Embedded C programs to read sensor data and upload to public cloud platform.
EE1111.3. Use Python-based IDE (integrated development environments) for the Raspberry Pi
EE1111.4. Interface Raspberry Pi with I/O devices.
EE1111.5. Visualize sensor data uploaded on public cloud.
EE1111.6. Apply standard protocol(s) for implementation of IoT Systems.
EE1111.7. Analyze and Improve existing systems with innovative IoT based approaches.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
EE1111.1								1		1	1						
EE1111.2							1	1	1		1						
EE1111.3								1		1							
EE1111.4								1	1	1	1		1	1			
EE1111.5							1	1		1	1			1			
EE1111.6									1	1			1	1			
EE1111.7									1	1	1						

Course Code: PR1101

Course Name: Automation Project

Course Outcomes: On successful completion of this course, the students should be able to:

PR1101.1. Design and implement a complete project in IoT/Automation using microcontroller/SOC interfaced with sensors or any other automation hardware/tools.

PR1101.2. Apply anyone/more standard data communication/IoT protocol(s).

PR1101.3. Use cloud servers for data streaming/logging and analytic techniques.

PR1101.4. Implement algorithms/signal processing using the data at edge/cloud.

PR1101.5. Deploy techniques to conserve bandwidth/energy/other resources and achieve cost economy for project.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
PR1101.1	2				2					2		2		3			
PR1101.2						2											
PR1101.3							2										
PR1101.4	2								2								
PR1101.5					2		2										

Course Code: PS1101

Course Name: Practice School – I

Course Code **:** ME1110
Course Name **:** Design of Machine Elements- ME1110
Course Outcomes **:**

5. Design and evaluate shafts to work under different service loading conditions as per ASTM/BIS standards.
6. Design bearings for various applications as per ASTM/BIS standards.
7. Design, evaluate gears for various applications as per ASTM/BIS standards.
8. Design springs for various systems as per ASTM/BIS standards.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO-2
ME1110.1	1	1			1	1	1	1						1		2	2
ME1110.2			1	1	1	1	1	1						1		2	2
ME1110.3	1			1	1	1	1	1	1					1	1	2	2
ME1110.4	1			1	1	1	1	1	1					1	1	2	2

Course Code **:** ME1111
Course Name **:** Automobile Engineering
Course Outcomes **:**

5. Identify different part of the automobile.
6. Design and explain the working of various parts like engine, transmission, clutch and brakes.
7. Design a steering and suspension system.
8. Identify Euro6 standards for automobile emissions.

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO-2
ME1111.1	1		1	1	1	1	1				1			1	1	2	2
ME1111.2	1	1	1	1	1	1					1			1	1	2	2
ME1111.3	1	1	1	1	1									1	1	2	2
ME1111.4	1	1		1	1		1							1	1	2	2

Course Code: CC1106

Course Name: Critical Thinking for Decisions at Workplace

Course Outcomes: After course completion, the student will be able to

CC1106.1. Apply techniques of Critical Thinking to analyse organisational problems through positive inquiry

CC1106.2. Describe and analyse appropriate problem-solving and ethical decision-making processes

CC1106.3. Choose the most effective and logical decision among multiple alternatives

CC1106.4. Evaluate solutions and anticipate likely risks based on purpose, context and ethics

Course Outcome	Correlation with program outcomes															Correlation with program specific outcomes	
	PO 1	PO 2a	PO 2b	PO 2c	PO 3a	PO 3b	PO 3c	PO 4a	PO 4b	PO 4c	PO 5a	PO 5b	PO 6	PO 7a	PO 7b	PSO-1	PSO -2
CC1106.1	1										2		2				
CC1106.2	2					1		2					1				
CC1106.3									1		1	2	1				
CC1106.4							1	2				2					

Course Code: PR1103
Course Name: Minor Project

Course Code: PS1102/ PR2107/ PR1105/ PR1104
Course Name: Practice School-II/ Industrial Project-II/ Entrepreneurial Project/ Research Project